Lab Perspectives™

A Publication of Glidewell Laboratories

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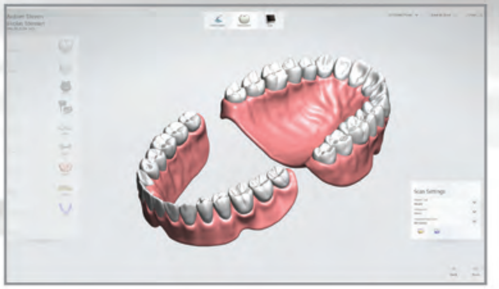

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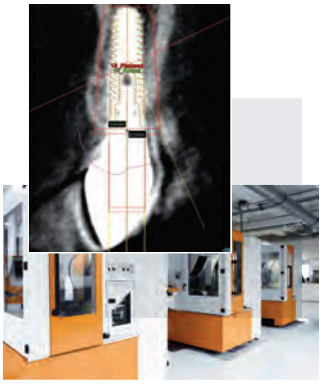

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Editor's LETTER

In 2013, conducting business as usual was not an option for dental laboratories, and the new year promises more of the same. After years of technological stagnation, the dental world now seems to change before our eyes. The development of new dental materials and equipment — or at least the refitting of existing industrial equipment to the needs of the dental laboratory — is a booming enterprise.

Keeping up with this new era of rapid change is a monumental challenge, and there is a genuine concern about being left behind: We know that we need to adapt, but do not necessarily know how or where to invest. But standing still and waiting is the wrong thing to do. CAD/CAM is not going away. Monolithic materials have more than just a foot in the door. Implants are soaring. And underscoring all these advances are the debates between saving labor costs and maintaining loyalty to our human resources, a resolution to which is at the top of the to-do list now more than ever.

In 1995, Jim Glidewell cited an old business axiom in a letter to his colleagues: "If a business is not growing, it is in the process of dying." I believe that to be true. As long as we embrace the change, we will adapt to it. New business models are being developed and are emerging; monolithic materials will get even better than they already are; CAD proposals will be 99% reliable and happen at superspeed; CAM will become more fully automated throughout the entire manufacturing process. A hand-stacked anterior crown will become an expensive relic, just as a hand-stacked posterior crown already is today. Call it a Rolex. Same thing.

It is with this in mind that we created *Lab Perspectives*. Magazines that demonstrate how to do artistic, food-color ceramic buildups are already out there, and they do a good job — I love to be informed and educated on those topics as well. But with this magazine, we will cut through the hype and confusion surrounding digital dentistry and bring the facts; facts that will help with informed business decision-making down the road. This is what we think will be most helpful in these times.

In that spirit, please accept this first issue of *Lab Perspectives*. We hope it will be of great value in helping you continue to grow your business.

Mit freundlichen Grüßen (With kind regards),

Friebauer

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After military service in Southeast Asia, Jim Glidewell attended a two-year dental technology program at Orange Coast College in Orange County, Calif., graduating in 1969. He formally opened Glidewell Laboratories in January 1970, and by 1981, he operated nine dental labs in Southern California. As president and chief executive officer of Glidewell Laboratories, he has been instrumental in developing new equipment and techniques with the objective of holding down dental laboratory expenses. He also directs the Research and Development department in generating cost-effective dental restorations. Contact him at labperspectives@glidewelldental.com.

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Zach Dalmau began his dental career in 2006 at the nSequence Center for Advanced Dentistry in Reno, Nev., where he was the director of guided implant surgery and 3-D diagnostic imaging. In September 2009, he moved to Baltimore, Md., to work at Materialise Dental Inc. There, he managed the design and production of all SimPlant® SurgiGuides®. Zach joined Glidewell Laboratories in 2011, and plays a key role in in the R&D's efforts for digital treatment planning and implant manufacturing. Contact him at labperspectives@glidewelldental.com.

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ROB NAZZAL

Rob Nazzal graduated with a degree in computer science from Cornell University, and contributed to significant improvements in technical fields such as residential services, network security and computerized logistics. He joined Brontes Technologies, whose assets were later acquired by 3M to establish the software for the Lava™ C.O.S. Rob cofounded Custom Automated Prosthetics, a provider of digital solutions for dental laboratories that aims to address the emerging needs of the dental industry. Contact him at rob@cap-us.com.

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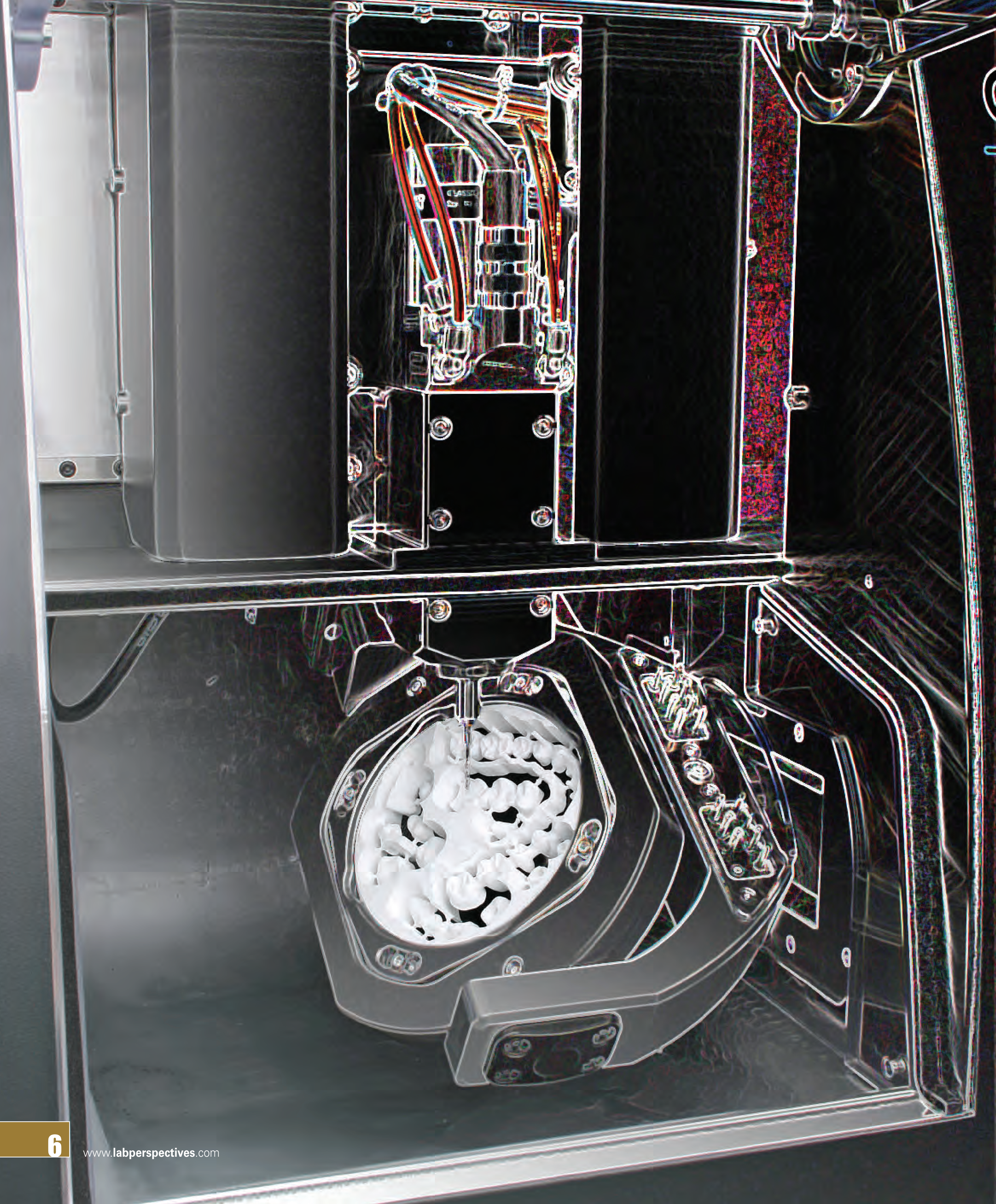


4-AXIS VS. 5-AXIS
Milling MACHINES:
The Numbers Game

article by

David Leeson

David Leeson is engineering manager at Glidewell Laboratories and recipient of the 2004 Lord Austin Prize for Manufacturing Engineering from the British Institute for Electrical and Electronics Engineers.

As with so many fabrication industries, the temporal and economic advantages afforded by digital CAD/CAM technologies have revolutionized manufacturing in dental laboratories. Increasing hardware and software sophistication joins decreasing upgrade costs in a capitalistic one-two punch that continues to supplant cast-and-burnout production methods of prosthetics and components.

To compete for business from dentists accustomed to short in-lab working times and minimized costs, laboratory decision makers may be tempted to purchase the latest in cutting-edge technologies under the assumption that better equipment will translate to larger profit margins. However, when it comes to milling machines, the bigger-is-better axiom is anything but certain. The manufacturing freedom granted by that extra axis comes at significant cost beyond the one-time purchasing fee, and any decision to acquire such a machine should be preceded by a thorough cost-benefit analysis.

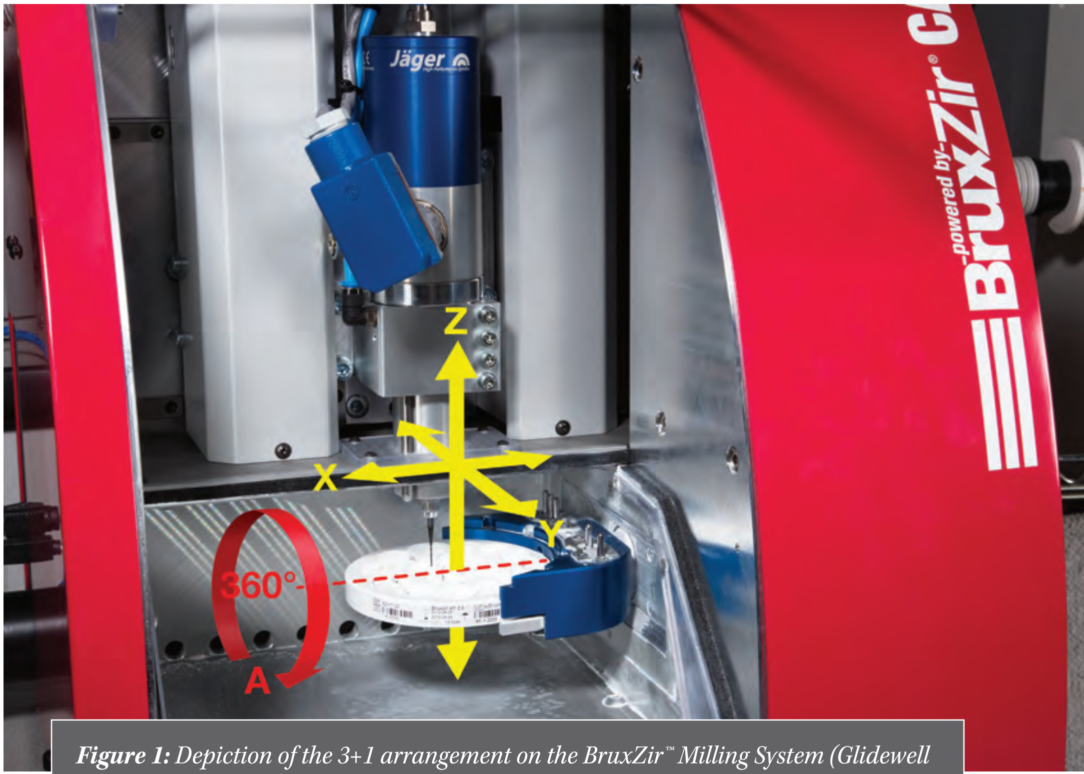


Figure 1: *Depiction of the 3+1 arrangement on the BruxZir™ Milling System (Glidewell Laboratories; Newport Beach, Calif.).*

Any machine created to mill in a three-dimensional space must start with the three core linear axes: a horizontal axis (x), a depth axis (y), and a vertical axis (z). Facing a vhf CAM 4-K4 Impression Milling Machine (vhf camfacture AG; Ammerbuch, Germany), one can see this principle in action: The milling tool moves left-to-right (x-axis) and up-and-down (z-axis), while the machine's disc clamp moves forward-and-backward (y-axis). From this simple configuration, the tip of the tool can reach any point within the work cube.

Of course, it's safe to presume no lab in history has been asked to deliver a restoration in the shape of a perfect cube. For the tip of the tool to reach a point on the surface of a convex shape below the height of contour, rotational axes that position the angle of the milling block are necessary. A fourth tilt axis (a-axis) is added in the case of the vhf K Series, around which the milling disc rotates *(Fig. 1)*. With this 3+1 arrangement of axes, most shapes encountered in re-

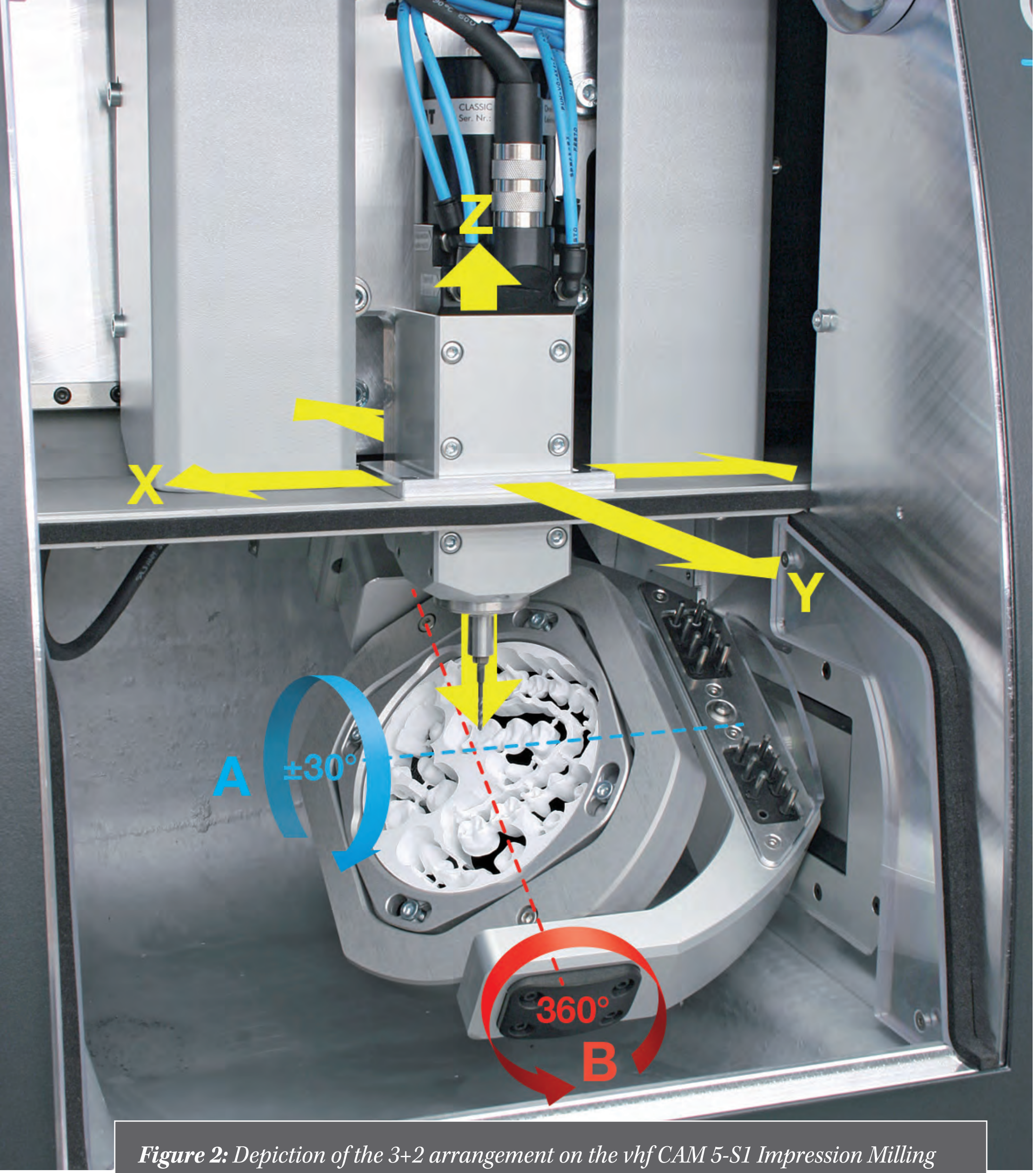


Figure 2: *Depiction of the 3+2 arrangement on the vhf CAM 5-S1 Impression Milling Machine (Photo courtesy of vhf Camfacture).*

> “When mimicking organic shapes … the forms cannot be sculpted by varying the relative angle of the tool in a single pass. Rather, … a shape is created through multiple passes of the tool’s spherical tip.”

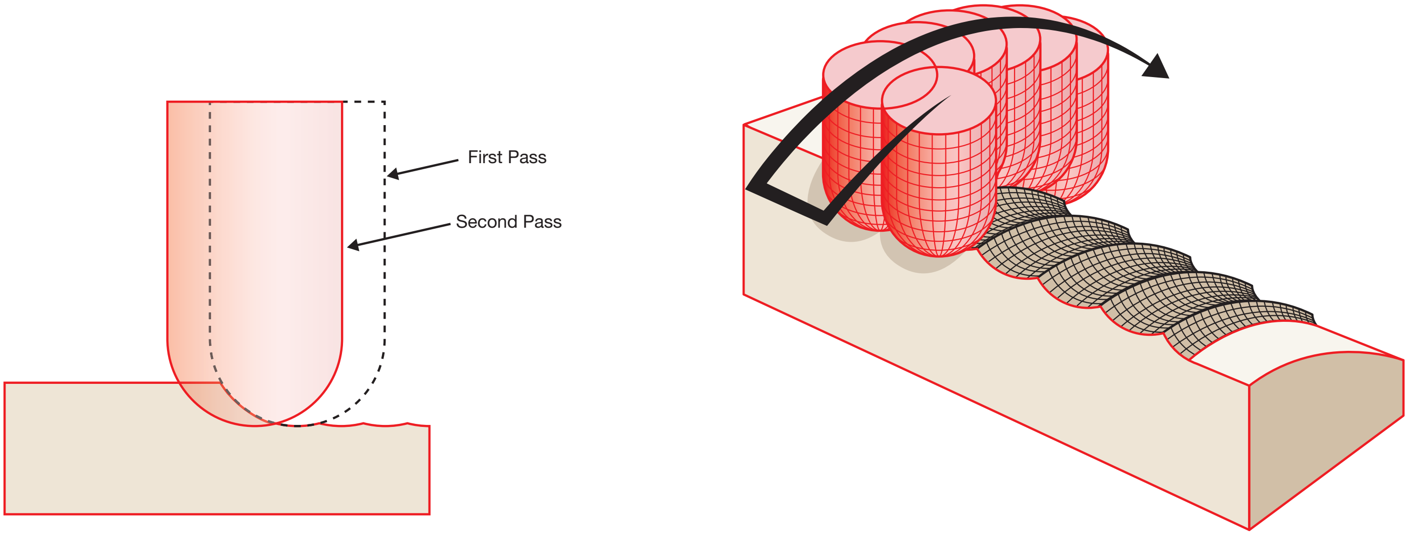
storative dentistry (crowns, bridges and so forth) can be created by milling everything above the conceptual “parting line,” then flipping the disc along the a-axis and milling everything below the same line.

But to really break the bonds of logistics and experience unchained milling autonomy, a fifth rotary axis (b-axis) is prescribed: a second rotational axis perpendicular to the a-axis *(Fig. 2)*. With the tilt and rotary axes working in unison, any facet of the milling component can be oriented upward; and with the sudden ability to orient any facet toward the milling tool while the x-, y-, and z-axes control spatial relation, no geometry, no matter how intricate, is beyond the machine’s capability to mill. In addition, while a 4-axis apparatus performs “indexed milling” — that is, incrementally tilts-and-pauses along the a-axis while the tool lifts-and-places — a 5-axis mill provides the opportunity for “continuous milling.” As in the case of the vhf CAM 5-S1 Impression Milling Machine (vhf camfacture AG), by altogether removing the disc clamp in exchange for the rotary capabilities of the fifth axis, the a-axis can be indexed while the b-axis continues to spin at high speeds. This allows the tool to remain in constant contact with the milling component while the rotary axis does the work of moving points along the component’s 3-D surface to the tool’s sculpting tip.

At first glance, the unlimited shape creation and apparent increase in speed efficiency might seem to make the purchase of the 5-axis milling machine over the 4-axis an obvious choice. True, the cost bump is significant: a vhf K Series runs just under $30,000, while the extra axis in the S Series pushes the price to $50,000. But how much money does a dental laboratory stand to lose by outsourcing — or worse, turning away — cases that require unrestricted milling capabilities? Won’t the additional business rapidly pay for the extra cost of the machine?

To answer these questions, the obvious starting point is to determine what the extra monetary and logistical costs really are. Unfortunately, cost-boosting disadvantages follow closely behind the advantages of that fifth axis. For example, the swiftness of its “continuous milling” capabilities is often hampered by the inescapably complex nature of organic shapes. In the industrial world, many of the shapes requiring fabrication can be made simply by running the 2-D shape of the tool surface across a 3-D path. Like in the case of a centrifugal jet engine impellor: The path of a milling tool can be matched to the form of an impellor blade, and the final shape of the blade made with a single movement through the metal merely by adjusting the orientation of the tool continuously throughout. This is because the shape, although complex, was designed by the human mind with an eye toward machining ease. Mother Nature, on the other

Axial Chip Thinning



Figures 3a, 3b: *Diagrams of the multiple passes required to create complex shapes with a spherical tool head.*

hand, does not engineer with the same concern for tool paths. When mimicking organic shapes — say, those in a 3-unit bridge — the forms cannot be sculpted by varying the relative angle of the tool in a single pass. Rather, the buccolingual surface must be generated using a surface machining technique, in which a shape is created through multiple passes of the tool's spherical tip. Any arbitrary shape, within the limits of the tip radius, can be created using this method; however, in order to create a smooth surface, the tool must make passes at increments as small as 50 microns *(Figs. 3a, 3b)*. This is a time-consuming reality, whether machining with five axes or three; and one which, provided the component is free from undercuts, nullifies any speed advantage afforded by extra axes.

In addition to the organic shapes in dentistry, engineering limitations also hinder the perceived speed increase of a 5-axis machine. Like a chain's weakest link, a milling machine is only as fast as its slowest moving part. In a Haas DT-1 equipped with a T5C 5-axis rotary table (Haas Automation; Oxnard, Calif.), for example, the x- and y-axis pack 2,550 lbs. of thrust each; the z-axis, 4,200 lbs. This provides linear motion up to 2,400 ipm at an acceleration rate of more than one g, allowing the tool and component to move very fast through the work cube. Conversely, physical limitations in the rotary gear box mechanism provide the a- and b-axis with only 210 ft-lbs. and 60 ft-lbs. of torque, respectively, resulting in a significantly reduced pace the machine must keep when the two additional axes are in motion.

With added degrees of freedom comes added maintenance as well, particularly in the form of sensitivity to inaccurate calibration. Each axis in a milling machine is accurate to within a certain distance range; and while there is some automation to ensure this range remains minimal, most dental milling machine providers limit this automated calibration to finding the axes' center of rotation. This is only one facet of the machine's complex mechanism, and does not truly test or adjust the positioning accuracy thereof.

To sustain the level of precision we demand at Glidewell, laser interferometers are required that can guarantee positioning inaccuracies remain inconceivably small — as tiny as +/-2 microns per linear axis. Still, inaccuracies are additive in nature; and since the milling tool mills at the vertex where multiple axes intersect, a rise in the number of axes necessarily precipitates a rise in the range of possible inaccuracy. If, for instance, the maximum 2-micron inaccuracy was made across each of the three linear axes, the tool would mill at a point 3.46 microns off the intended one. Similarly, accuracy ranges in a rotary table also compound and are typically the largest component of a positioning error, because the numbers quickly increase depending on the distance the programmed point lies from the center of rotation. Each of the previously mentioned Haas

> *“Inaccuracies are additive in nature; and since the milling tool mills at the vertex where multiple axes intersect, a rise in the number of axes necessarily precipitates a rise in the range of possible inaccuracy.”*

Restoration Type	4-Axis	5-Axis
Bars		●
Bridges — Anatomical	●	●
Bridges — Framework	●	●
Bridges — Screw-retained, 2 implants	○	●
Bridges — Screw-retained, > 2 implants		●
Crowns	●	●
Crowns — Screw-retained	○	●
Copings	●	●
Custom Abutments — from preform blank	○	●
Custom Abutments —Zirconia w/ Ti Connection	●	●
Inlays/Onlays	●	●

Figure 4: *The Likely (•) and Possible (○) manufacturing abilities of 4-axis vs. 5-axis milling machines by restoration type.*

T5C's additional axes provides a potential increased range of inaccuracy that builds upon the standard 2-micron inaccuracy of each linear axis. Vigilance in calibration becomes an imperative with more-complex milling machines.

Another financial pitfall lies in the complexity of the software needed to drive the machine. Although extremely rare, more moving parts increase the likelihood and severity of a collision. To combat this potential outcome, advanced CAM software and post processors sophisticated enough to keep all the parts moving in sync are required. But while these tools are adept at avoiding catastrophe, they are ineffective at avoiding sticker shock. Software driving a 5-axis milling machine ranges from $7,000–$20,000; and with annual maintenance packages billed at a percentage of the initial purchase amount (the standard fee structure, no matter how many axes), the costs quickly multiply beyond the already augmented purchase price.

Of course, while the extra costs and complexities of 5-axis machining are daunting, the astute laboratory decision maker might dismiss them with a sigh of resignation. After all, these must all be chalked up to the cost of doing business in an industry where five axes are a prerequisite to staying competitive. Right?

Therein lies the silver lining. The vast majority of dental restorations can be milled with a 4-axis milling machine *(Fig. 4)*. While five axes are required for shapes of excessive complexity (e.g., mesh frames for partial dentures or screw-retained bars and bridges where the screw holes are arranged at disparate angles parallel to the a-axis tilt), most shapes in restorative dentistry consist of surface points easily accessible by a 3+1 axis configuration. This includes crowns, bridges, copings, hybrid abutments, temporaries, veneers, and others that comprise the bulk of laboratory cases. Commonly, a 4-axis machine's supposed inability to mill one of these restorations stems not from a hardware inadequacy, but rather from bugs in the CAD software. For instance, certain design software may fail to orient the insertion direction of a 3-unit bridge toward the vertical before outputting the file. When exported to the 4-axis mill, the shape appears to have undercuts that can't be reached without a rotary axis; in reality, a simple rotation of the virtual model would render the 4-axis machine perfectly adequate to the task.

In the end, the decision to buy a 4- or 5-axis milling machine should rest heavily on the number of cases rolling through the laboratory that require the additional axis; and that number is often inflated. A 5-axis milling machine carries with it a significant increase in both upfront and continuing costs, moneys that may be better allocated to outsourcing the physical milling of complex cases if these restorations represent a low percentage of the laboratory's overall case load.

> *"The decision to buy a 4- or 5-axis milling machine should rest heavily on the number of cases rolling through the laboratory that require the additional axis."*

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Inclusive® Custom Implant Abutment Design Webinar

Course Synopsis

Take advantage of the Glidewell Laboratories outsourcing program for Inclusive® Custom Implant Abutments by sending a model to our Implant division for design and milling to be done on site, or take complete control over the final shape of your custom abutments by learning to design them yourself! In addition to training in the most efficient techniques of abutment design using the latest 3Shape design modules from Glidewell Laboratories, course participants will also gain insight into layout options for streamlining pre- and post-CAD production areas, and obtain a more robust understanding of CAD's role in today's high-tech dental laboratory.

Course Objectives

After completing this course, course participants will be able to:

- Design CAD abutments in 3Shape with the most up-to-date techniques
- Use the tools available in the 2012 module to design Inclusive Custom Abutments
- Troubleshoot common challenges in abutment design
- Understand the benefits of incorporating CAD into a modernized dental lab

Registration Options

Register online or call **866-791-9539** for registration assistance

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**Registered webinar attendees will receive further details about how to redeem the special offer upon completion of webinar. Special Rx offer only valid on first purchase of Inclusive abutments from Glidewell Laboratories. Inclusive is a registered trademark of Prismatik Dentalcraft Inc.*

Presented by
Alec Di Lullo, Implant Department CAD Supervisor

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Marketing MATTERS

My Experience as an Authorized BruxZir™ Laboratory

An Interview with Mark Jackson, RDT, Vice President and General Manager of Precision Ceramics Dental Laboratory

interview of

Mark Jackson

Mark Jackson, RDT, is vice president and general manager of Precision Ceramics Dental Laboratory, a full-service, DAMAS-certified dental laboratory located in Montclair, Calif., that he cofounded more than three decades ago after graduating from the Dental Technology Institute in Orange, Calif. In addition to always being on the hunt for new customers, Mark is also a big game hunter and displays some of his trophies in his lab. The experienced dental technician and lab owner recently took time to share how becoming an authorized distributor of BruxZir® Solid Zirconia (Glidewell Laboratories; Newport Beach, Calif.) through the Authorized BruxZir™ Laboratory program has benefitted his lab.

What made you decide to cooperate with a "competing" dental laboratory to jointly promote the BruxZir brand of solid zirconia?

We had been using full-contour zirconia crowns for several years on demanding veterinary cases, so we already had confidence in the material when used in this manner. I did have concerns about translucency and wear, however, so I never considered using it for humans. During a visit to Glidewell Laboratories for a CAD/CAM summit, I was shown a sample of the BruxZir material that was under development at the time. I knew immediately that it was a home-run product. I'm not even sure there were plans of any kind for an "authorized laboratory" program at the time; I just knew I wanted in, and I hounded Glidewell to include us.

More than 4.4 million BruxZir restorations have been prescribed by dentists across the nation in just 4 years.

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I've never considered Glidewell Laboratories to be a competitor, but rather a supplier, a resource and a partner. Our lab had used other Glidewell products in the past, such as Prismatik Clinical Zirconia™ (Glidewell Laboratories), so we knew the product would be extremely consistent, easy to use and affordable. We also knew it would be supported by some of the best marketing and research in the industry.

You mentioned your prior experience working with full-contour zirconia for veterinary cases. How did that come about?

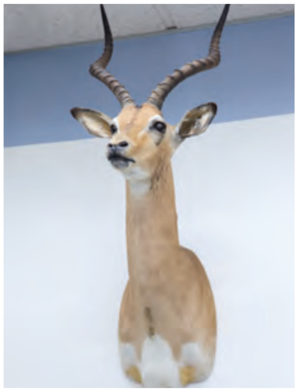
Our laboratory got involved in veterinary dentistry about 25 years ago, right in its very beginnings. Historically, we made stainless steel crowns for police dogs, military dogs and zoo animals. After landmark lawsuits regarding the Fourth Amendment and use of force, there was a move to try to reclassify police dogs as a weapon rather than a tool. These dogs would be shown in court with stainless steel crowns to show how intimidating, scary and damaging they could be. So I encouraged the doctors to consider tooth-colored alternatives, and the only thing I knew of that could withstand that kind of abuse was full-contour zirconia. This was using the old Lava™ framework-type zirconia from 3M™ ESPE™ (St. Paul, Minn.). As I mentioned before, it had issues with wear and translucency, so I never considered it something that would be useful for humans.

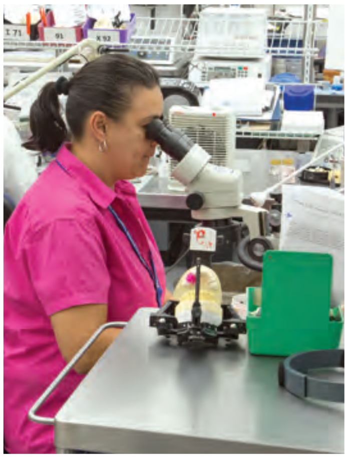
When I saw the BruxZir material at Glidewell, however, I could see how beautiful it could be. There was good documentation about the wear characteristics of the material and, as I said earlier, I knew it was going to be a home-run product. I already had confidence in zirconia because I had seen it used in the most demanding applications, and I knew that if Glidewell had dealt with the translucency and researched how the material wears, it would be perfect for humans.

Does your laboratory benefit from the national marketing exposure in ads, direct mailers and Web-based campaigns featuring Authorized BruxZir Laboratories?

Most certainly! Glidewell Laboratories has always had some of the best marketing materials in the industry, as well as a good sense of the depth of media that needs to be used to successfully promote a product. From the BruxZir website (www.bruxzir.com) and YouTube, to the printed mailers and coupon books, to speakers on the podium, the product has had an excellent presence in every media. All of these things combine to create a huge amount of momentum and name recognition for the BruxZir product, and that has certainly helped us. For better or worse, BruxZir Solid Zirconia has become the "Kleenex" of all-zirconia crowns. It's always easier to sell a name-brand product with lots of support than to try and sell a generic version. The branding and exposure has been a study in perfect marketing of a dental product.

Inside Precision Ceramics Dental Laboratory





How specifically has the cooperation worked for your laboratory in terms of new customers, revenue and profit on full-contour zirconia restorations?

Our laboratory has always been built around the introduction of new products. Historically, every time we experienced any kind of significant increase in new customers and sales, it corresponded with the release of a new product that differed from anything else available at the time. Some past examples are IPS Empress® (Ivoclar Vivadent; Amherst, N.Y.), Wol-Ceram® (Wolz Dental-Technik GmbH; Ludwigshafen, Germany), 3M ESPE Lava and IPS e.max® (Ivoclar Vivadent). Our BruxZir numbers, in terms of sales and number of new accounts, eclipsed those other products, despite a poor economy.

When BruxZir Solid Zirconia was introduced in early 2010, the market was ready for something new and innovative. The economy had slowed. Sales of the higher-priced "premium cosmetic products" had begun to slump. BruxZir zirconia was the perfect storm of economy, performance and innovation; it really fit the mood of the country at the time. People wanted value, and BruxZir crowns and bridges allow us to deliver that, without taking a haircut on profits. Monolithic crowns require significantly less labor then traditional layered ceramic crowns, which allowed us to have a lower selling price (about two-thirds that of our previously popular product), yet still maintain profit levels equal to or even better than what we were seeing with the layered crowns. Additionally, turnaround times were cut by more than half. Right now, BruxZir crowns are leaving this laboratory in about a 48-hour turnaround period, and that is a huge advantage over any other type of crown. Then there's the accuracy of the CAD/CAM used to produce it, which means we have better fits, higher patient and doctor satisfaction, and lower remakes than any other product we've ever had. I believe our current failure rate for BruxZir Solid Zirconia is .09 percent, which is the best of any product. The only thing close to that is a full-cast metal crown. So monolithic restorations are more profitable, have fewer remakes and returns, and cut turnaround times in half. It's a win-win for everybody!

Do you have anything else you'd like to share with other dental labs about CAD/CAM processing and monolithic-type dental restorations?

Monolithic crowns and CAD/CAM manufacturing are helping to bring dental technology jobs back to America. Among statistics reported at the 43rd Annual Session of the American College of Prosthodontics in Las Vegas, Nev., the number of technicians in this country has grown 3.2 percent over the past 12 months, and wages have grown by 4.5 percent. I really believe we are beginning to see what will become a surge in the "re-shoring" of dental technology in the U.S. As labs begin to embrace the benefits of CAD/CAM manufacturing and digital impressioning, we may never face another threat of losing business to foreign labs, and we are well prepared to compete with chairside mills. I've never been more excited for the lab industry. LP

Mark Jackson, RDT, is a member of ICOI and Cal-Lab, and serves on the board of directors of the National Association of Dental Laboratories. Contact him at 909-625-8787 or info@pcdl-usa.com.

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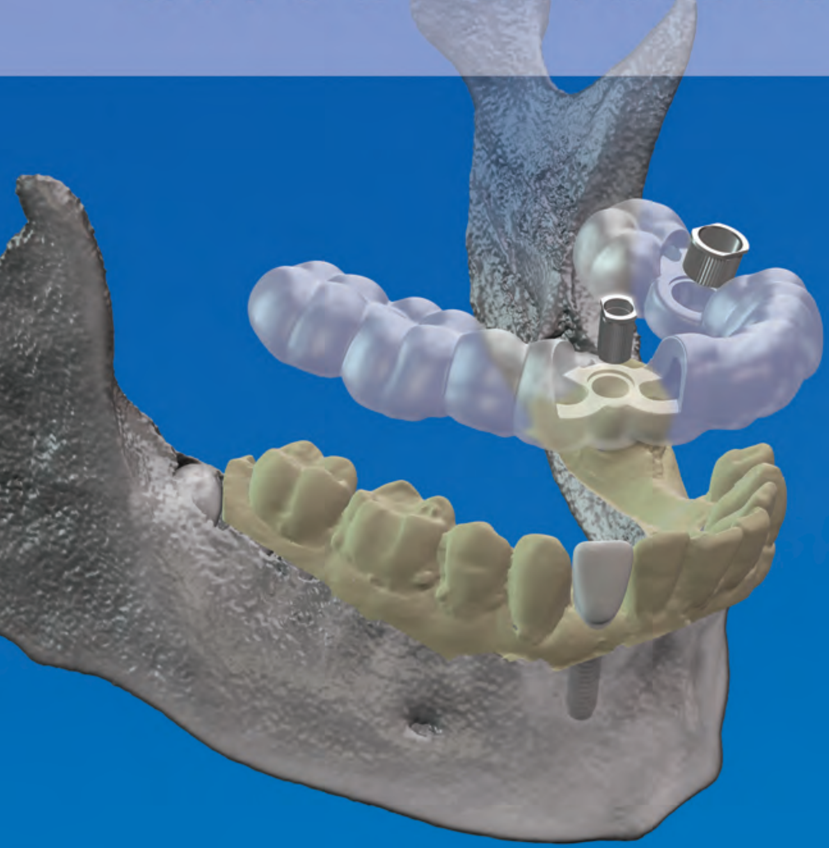

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Outsourcing
INCLUSIVE® TITANIUM ABUTMENTS
Utilizing UCLA Plastic Abutments

article by

Darius Raudys

Darius Raudys oversees the Fixed division of Glidewell Laboratories' Implant department, and is a material contributor to the company's Inclusive® Tooth Replacement and Tissue Contouring System strategy.

Although in-house CAD/CAM systems can be extremely expensive, the benefits of digital implant dentistry are still accessible even without this large, upfront investment. Outsourcing of custom abutment fabrication achieves the same prosthetic outcome with little investment in equipment and training.

Stock implant abutments lack the personalized contours that create ideal emergence profiles and marginal adaptation, while custom abutments are anatomically optimized for each patient. By outsourcing custom abutment manufacturing, labs of any size can offer their doctors access to increased precision. Inclusive® Custom Implant Abutments (Glidewell Laboratories; Newport Beach, Calif.) optimize soft-tissue contours and aid in the creation of a natural-looking emergence profile. They are available in Titanium, Zirconia with Titanium Base, and All-Zirconia to fit the individual needs of patients. Of the three configurations, titanium abutments are the most widely prescribed type of custom abutment among dentists, due to their strength and versatility for any region in both the upper and lower arches. Utilizing Inclusive® UCLA Plastic Abutments (Glidewell Direct; Irvine, Calif.) with Glidewell Laboratories' outsourcing program allows a lab of any size to offer CAD/CAM accuracy at a fraction of the cost. Available through Glidewell Direct, the plastic abutments are compatible with implants from the following manufacturers: BIOMET 3i, CAMLOG, DENTSPLY Implants, Prismatik Dentalcraft, Nobel Biocare, Straumann and Zimmer Dental.

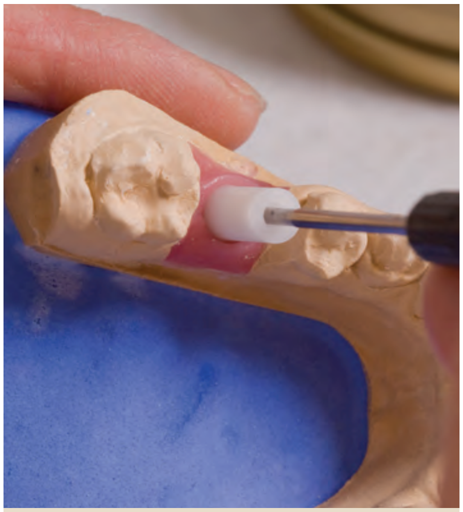


Figure 1

Laboratory Procedure

To begin the abutment wax-up design, the appropriate Inclusive UCLA Plastic Abutment is selected for the implant manufacturer and size required for the case. Once the plastic waxing sleeve is removed from the package, the screw is inserted through the top so that the threaded end emerges through the implant connection. Then, the plastic sleeve is placed onto the implant analog in the soft-tissue model until the implant connection and analog are fully engaged *(Fig. 1)*. The UCLA is then screwed securely into place, with care taken not to overtighten, as this may cause the plastic to deform or the screw head to be damaged. Using the specific

Figure 1: *The UCLA plastic abutment is placed onto the implant analog in the soft-tissue model. Note: The sleeve must be fully engaged with the analog.*

driver for the implant analog being used will make the abutment much easier to remove.

A low-speed handpiece with a heatless grinding wheel is then used to reduce the height of the abutment to allow for occlusion of the models *(Fig. 2)*. When satisfactory clearance is reached, a high-speed bur is utilized to refine and shape the plastic sleeve *(Fig. 3)*.

At this stage, the technician should ensure that all plastic debris is removed from the UCLA before applying wax to build it up. A band of wax (BEGO Foundation Wax [BEGO USA; Lincoln, R.I.]) is applied to the free gingival margin around the abutment. Once the wax has cooled, the screw is loosened and removed so that the implant connection is free from the model. The wax band will clearly identify the gingival margin and provide visible feedback concerning the depth of tissue at the abutment site *(Fig. 4)*.

Next, the technician uses wax of a different color (Slaycris Wax [Slaycris Products; Portland, Ore.]) and begins designing the subgingival portion of the abutment *(Fig. 5)*. This helps visibly identify the transition from the tissue, while also highlighting the crown margin line. The technician continues adding wax to the UCLA until the desired abutment contour and emergence profile are achieved. With the wax shape at the abutment's base con-

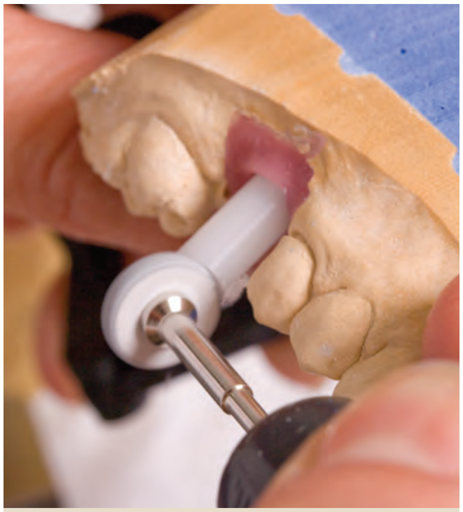
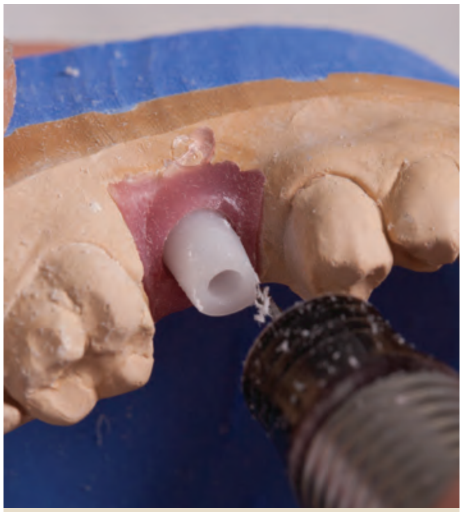


Figure 2



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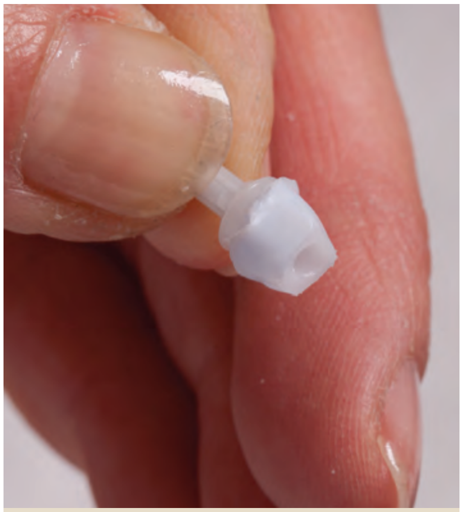

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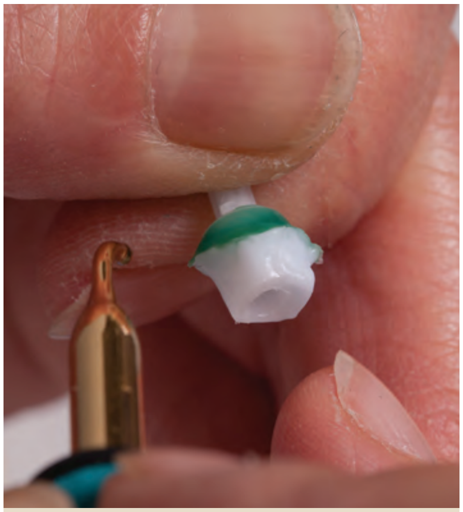

Figure 5

> *“A low-speed handpiece with a heatless grinding wheel is used to reduce the height of the abutment to allow for occlusion of the models. When satisfactory clearance is reached, a high-speed bur is utilized to refine the shape of the plastic sleeve.”*

Figure 2: *A low-speed handpiece with a heatless grinding wheel is used to reduce the size of the abutment.* ***Figure 3:*** *A high-speed bur is used to further reduce and contour the abutment.* ***Figure 4:*** *The hardened wax band marking the tissue level of the model.* ***Figure 5:*** *A green colored wax is utilized to design the subgingival portion of the abutment.*

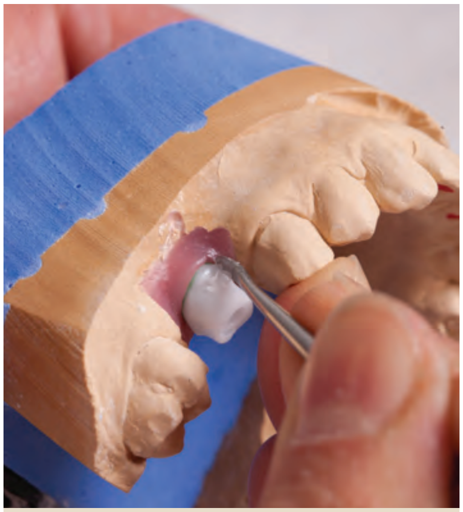

Figure 6

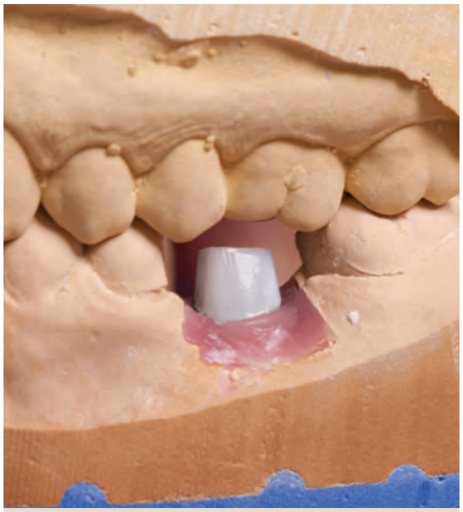

Figure 7

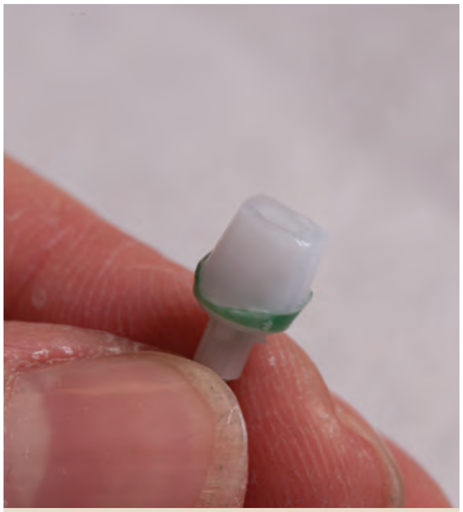

Figure 8

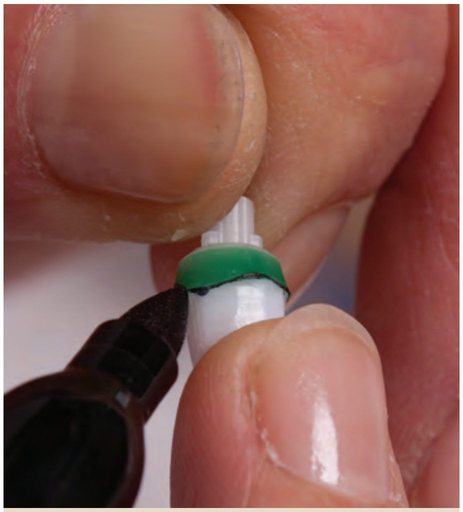

Figure 9

***Figure 6:** The UCLA abutment is placed back on the model, and the tissue is contoured at the gingival margin of the abutment as desired. **Figure 7:** The occlusal of the abutment is shaped to satisfy the requirements of the crown to be used to restore the tooth. **Figure 8:** The green wax colors on the abutment visibly distinguish the tissue transition. **Figure 9:** A black marking pen can be used to further identify the tissue transition.*

toured as desired, the technician places the UCLA sleeve back on the soft-tissue model *(Fig. 6)*. The UCLA and the implant analog must be completely engaged and fastened securely with the screw to ensure complete accuracy.

The technician then guarantees that the fit of the abutment and model is satisfactory before continuing on to the waxing of the top cap. Wax is applied as needed to achieve the appropriate shape for the tooth being replaced.

With the waxed UCLA still in place on the model, the technician then begins removing wax and shaping the top cap as required *(Fig. 7)*. The previously placed colored wax provides a clearly visible marker identifying the tissue transition *(Fig. 8)*. Additional visibility can be achieved by using a black marking pen to clearly highlight the margin line *(Fig. 9)*.

When the design of the abutment is deemed satisfactory *(Fig. 10)*, it is sent to Glidewell Laboratories for scanning. In

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> *“For laboratories that do not have advanced technological capabilities, this simple outsourcing solution provides them with the competitive advantage that CAD/CAM precision can bring to a business.”*

just three working days, a milled titanium duplicate of the wax abutment will be fabricated and sent back to the customer. For laboratories that do not have advanced technological capabilities, this simple outsourcing solution provides them with the competitive advantage that CAD/CAM precision can bring to a business.

Outsourced Scanning and Digital File Creation

When the articulated models and waxed UCLA reach Glidewell Laboratories, the setup is ready to be placed into a digital workflow. First, the UCLA is scanned both in and out of the stone model. Then, scans of the opposing arch and both arches in articulation are captured. The four scans combine to form a full digital model of the mouth. A design technician uses 3Shape Dental Designer™ (3Shape Inc.; New Providence, N.J.) to match the contours of the digital replica to those of the scanned model, creating a millable digital file.

Milling

With the design completed, the file is exported to a top-of-the-line Haas 5-axis CNC milling station (Haas Automation Inc.; Oxnard, Calif.) for precision milling from a titanium blank *(Fig. 11)*. Once milled, each Inclusive Custom Abutment undergoes a rigorous quality control process. This comprehensive inspection is conducted to ensure optimal fit and design.

Conclusion

The end result of this outsourcing process is a custom solution at or near the cost of a prefabricated abutment that is delivered to the customer in just a three-day turnaround *(Fig. 12)*. Experienced hand-fabrication combined with the accurate tolerances provided by computer-aided machinery create a desirable custom abutment solution for esthetic implant cases. Although a prefabricated implant abutment may appear to be a quicker, less expensive solution, in nearly every case, the benefits provided by a patient-specific custom abutment will deliver more reliable function and natural esthetics.

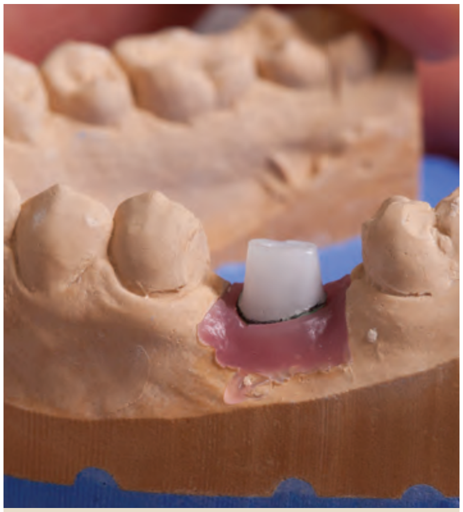

Figure 10

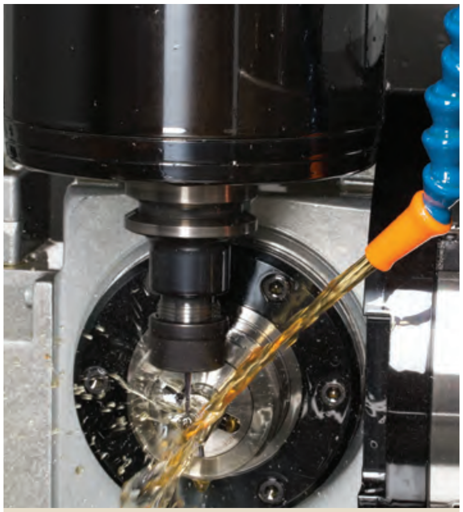

Figure 11

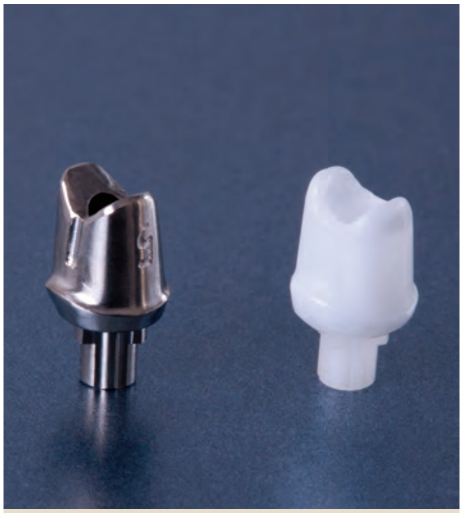

Figure 12

Figure 10: *Final waxed UCLA abutment in stone model.* ***Figure 11:*** *Titanium abutments being milled on a Haas 5-axis CNC mill.* ***Figure 12:*** *The final Inclusive Custom Titanium Abutment and matching wax design.*

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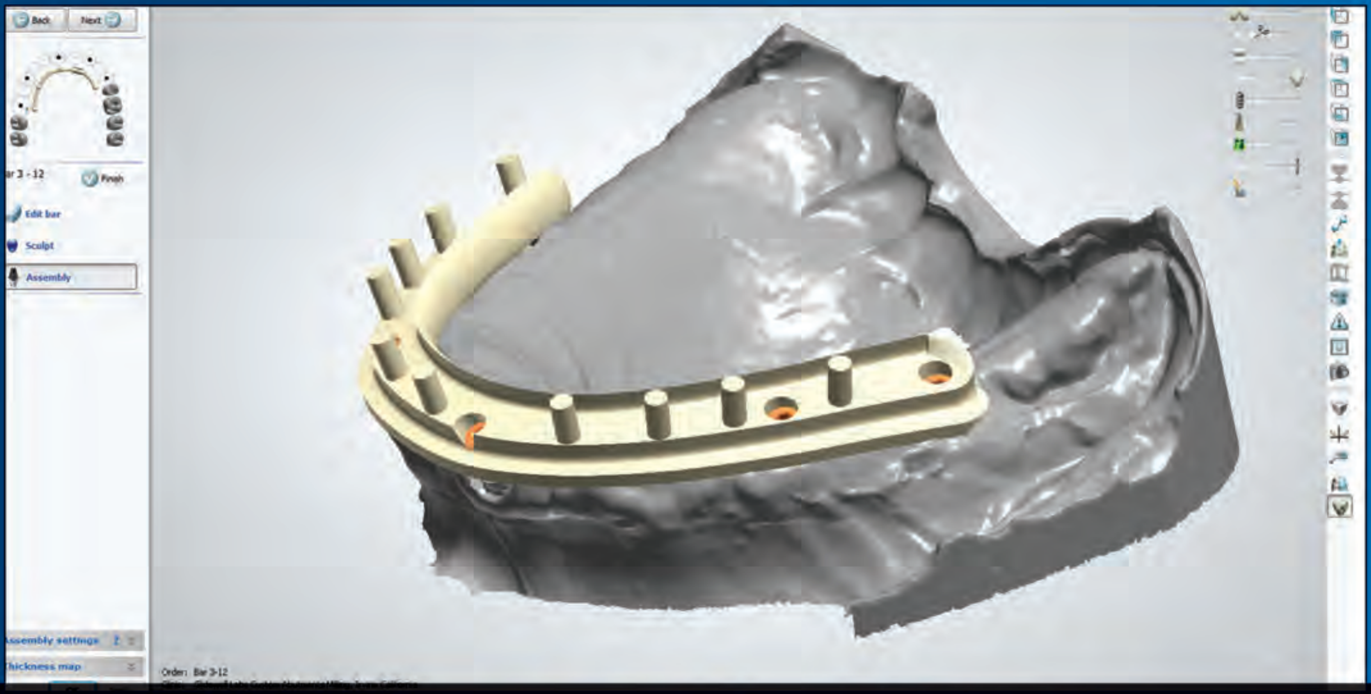

Remote Bar Design Webinar

Course Synopsis

As part of the Glidewell Laboratories Inclusive® Remote Bar Design program, labs can design their own implant bars using the 3Shape system and the 2012 Implant Bar and Bridge Design module. This webinar will cover the many tools in 3Shape that can be utilized for implant bar design and will outline the essential steps of the creative process. Learn to design for yourself today!

Course Objectives

After completing this course, participants will:

- Understand how to create a new work order in 3Shape, choosing the correct library needed for implant bar design
- Be aware of the A-P spread and how to employ it in 3Shape
- Be able to follow default parameters and utilize the necessary tools in 3Shape
- Understand the basic steps of bar design and how to inspect areas for appropriate milling

Presented by
Christopher Tran, Implant Department Team Leader

Dates and Time
April 15, 2014
May 13, 2014
7:30 a.m. PST

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GLIDEWELL LABORATORIES

Back to BASICS:

The Fundamentals of Hiring Dental Technicians in the Digital Age

article by

Wolfgang Friebauer

Wolfgang Friebauer, MDT, CDT, is the editor-in-chief of Lab Perspectives magazine and director of education and research & development for Glidewell Laboratories.

One of the integral components of our success here at Glidewell Laboratories has been, and continues to be, our employees. We adhere to a simple principle: Hire great employees, and you will build a better business. This is particularly true when it comes to dental technicians. As the age of digital dentistry advances, hiring dental technicians with a mind for digital technologies will become increasingly vital to your lab's ability to thrive in this booming era.

When sitting across the interview table from a technician candidate, some of the most important things to look for are consistent with the qualities sought for any potential employee: a firm motivation to work; a desire to do the job right; a genuine interest in the field; and above all, a positive attitude. Beyond that, a steady grasp on the basics of dental technology and a mastery of dental terminology provide a solid foundation that can be easily expanded and enhanced by in-house education. As the employer, it is your responsibility to keep continuing education alive by offering and encouraging further learning opportunities.

But what are the key aptitudes and auspicious skills that identify an applicant as a good candidate for a dental technician position right off the bat? As rudimentary as it may seem, possessing the knowledge of the tooth numbers is still an indispensable skill for a successful technician. A solid understanding of the fundamentals of occlusion, anatomy, classes of malocclusion, prepped margin styles and CAD/CAM technology are also vital components of a good technician's toolkit. Beyond a basic understanding of dentistry, finding a technician who is competent in computer technology is paramount. Candidates should be armed with fundamental computer knowledge, as the computer-savvy technician is better equipped to swiftly adapt and master the emerging machinery and processes of expanding dental technology. You might as well end the interview on the spot if the candidate is unfamiliar with computers or shows the slightest sign of technophobia.

Here at Glidewell Laboratories, as one of the preliminary steps of the interview process, we require all candidates to take a two-minute math test. Prior to the arrival of CAD/CAM technology, we eagerly sought out technicians with innate artistic ability. Did he or she enjoy sculpting? Building model airplanes and the like? These were indicators that the candidate would be skilled in designing, a knack for art that would often carry them through the ineludible onslaught of complex cases and demanding doctors. However, artistic ability is diminishing in importance: The truth is, fabricating teeth is now closer to engineering than most would like to admit. The CAD library, created by nature and loaded by IT personnel, will be the future artist. So now, we lean toward the mathematician when choosing dental technicians, because they often possess vital problem-solving abilities that the "artist" may lack.

But why all this emphasis on going digital in the first place? While there are a myriad of reasons, the most attention-grabbing are the establishment of a standard quality consistency and the financial savings afforded the laboratory through a lessening of expenditures. Utilizing digital technology in the lab not only cuts down on workforce costs by using cheaper computer labor to do the job of a human, but also reduces your manufacturing costs by incurring fewer remakes due to the CAD/CAM system's precision. In essence, it is the difference between doing math manually and allowing a calculator to do it: Errors can be eliminated by automating the procedure with computer programming, and allowing the human to take a supervisory role. When left to his or her own devices, even the best technician delivers a "Monday crown" once in a while. A venture into the digital world will reap many benefits and propel you to arrive on time to the future of dentistry.

And that future belongs to CAD/CAM technology. Laboratories who desire to lead the way have a unique opportunity to stay ahead of the game by making the transition over to digital dentistry, with the success of that move depending on hiring the right technicians. When a technician shows up the first day at your lab with a base knowledge of materials, science, biology and function, and is well acquainted with computer technology, you can rest assured that their transition into digital dentistry will, in all probability, be a smooth one. LP

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CLINICAL AND LABORATORY PRODUCTS

BruxZir® SOLID ZIRCONIA:

What Is It and Why Does It Work?

article by

Robin A. Carden

Robin Carden is vice president of R&D at Glidewell Laboratories and winner of the 1998 Design Engineering Award from *Design News*.

Zirconia, a unique advanced ceramic, has been a popular dental material for the last several years that is widely used for the fabrication of crown copings, bridge frameworks and custom implant abutments. More recently, however, dental use has trended toward full-contour (monolithic) zirconia. BruxZir® Solid Zirconia (Glidewell Laboratories; Newport Beach, Calif.) is an advanced, full-contour zirconia restoration with no porcelain overlay that has been refined from zirconium oxide powder to produce the strongest and most reliable all-ceramic to date. This article provides a material science overview of zirconium dioxide (ZrO_2), also known as zirconium oxide or zirconia, one of the most studied ceramic materials in the world.

Zirconium dioxide is commercially available in two basic forms: naturally as the mineral baddeleyite; and synthetically as zirconia powder, synthesized from zircon sand ($ZrO_2 \cdot SiO_2$) using a solid-state reaction process. Several oxides are added to zirconia to stabilize both the tetragonal and cubic phases: among them magnesium oxide (MgO), yttrium oxide (Y_2O_3), calcium oxide (CaO), and cerium(III) oxide (Ce_2O_3). BruxZir Solid Zirconia is manufactured from yttria-stabilized zirconia (YSZ) powder *(Fig. 1)*, which exhibits superior mechanical properties such as high strength and fracture toughness. A technological breakthrough, YSZ surpasses the strength limitations of traditional fine ceramics, and has the potential for use in a wide variety of applications: everything from telecommunications, to energy and to environmentally friendly products.

Partially stabilized zirconia like BruxZir Solid Zirconia is an ideal material for dental restorations because of five physical properties: flexural strength, fracture toughness, resistance to thermal shock, translucency and color.

Figure 1: *BruxZir Solid Zirconia is manufactured from yttria-stabilized zirconia (YSZ) powder.*

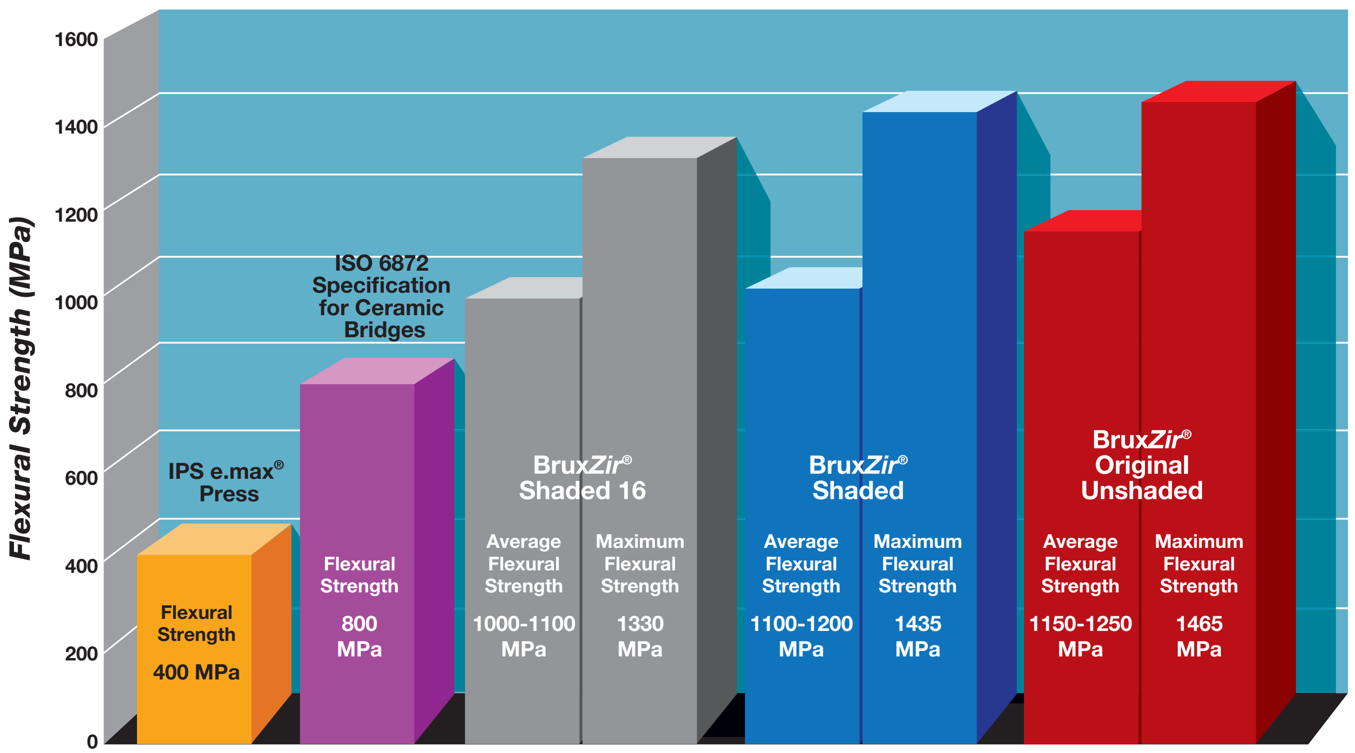

Figure 2: *Lithium disilicate ceramic has a flexural strength of 400 MPa while zirconia materials exhibit more than 1000 MPa. However, because of post-powder processing, BruxZir Solid Zirconia exceeds that strength threshold, with flexural strengths up to 1465 MPa.*

The first unique physical property exhibited by BruxZir Solid Zirconia is high flexural strength. Typical partially stabilized zirconia materials have flexural strengths near 1,000 MPa. However, because of post-powder processing, BruxZir Solid Zirconia dental restorations are able to exceed that strength threshold, with flexural strengths up to 1,465 MPa *(Fig. 2)*.

BruxZir Solid Zirconia also exhibits high fracture toughness, or K_{Ic} value. This is due to a unique event that occurs when a crack is encountered in partially stabilized zirconia known as phase transformation toughening. Normally, cubic grains constrain the tetragonal precipitates that want to expand and release associated energy. However, when these grains are faced with a propagating crack tip, the energy is released, and the tetragonal phase changes back to the more stable monoclinic phase. This results in the associated volumetric expansion, effectively closing the advancing crack — a kind of self-healing that also gives the material high impact resistance.

In the field of mechanical properties, strength and toughness are not the same thing. Brittle materials may exhibit significant tensile strength by supporting a static load. Toughness, however, indicates how much energy a material can absorb before mechanical failure. Fracture toughness is a property that describes the ability of a material with inherent micro-structural flaws to resist fracture via crack growth and propagation; a quantitative way of expressing a brittle material's resistance to fracture when a crack is present. This is one of the most important properties of any brittle material for virtually all design applications, and methods have been devised to modify the yield strength, ductility and fracture toughness of both crystalline and amorphous materials.

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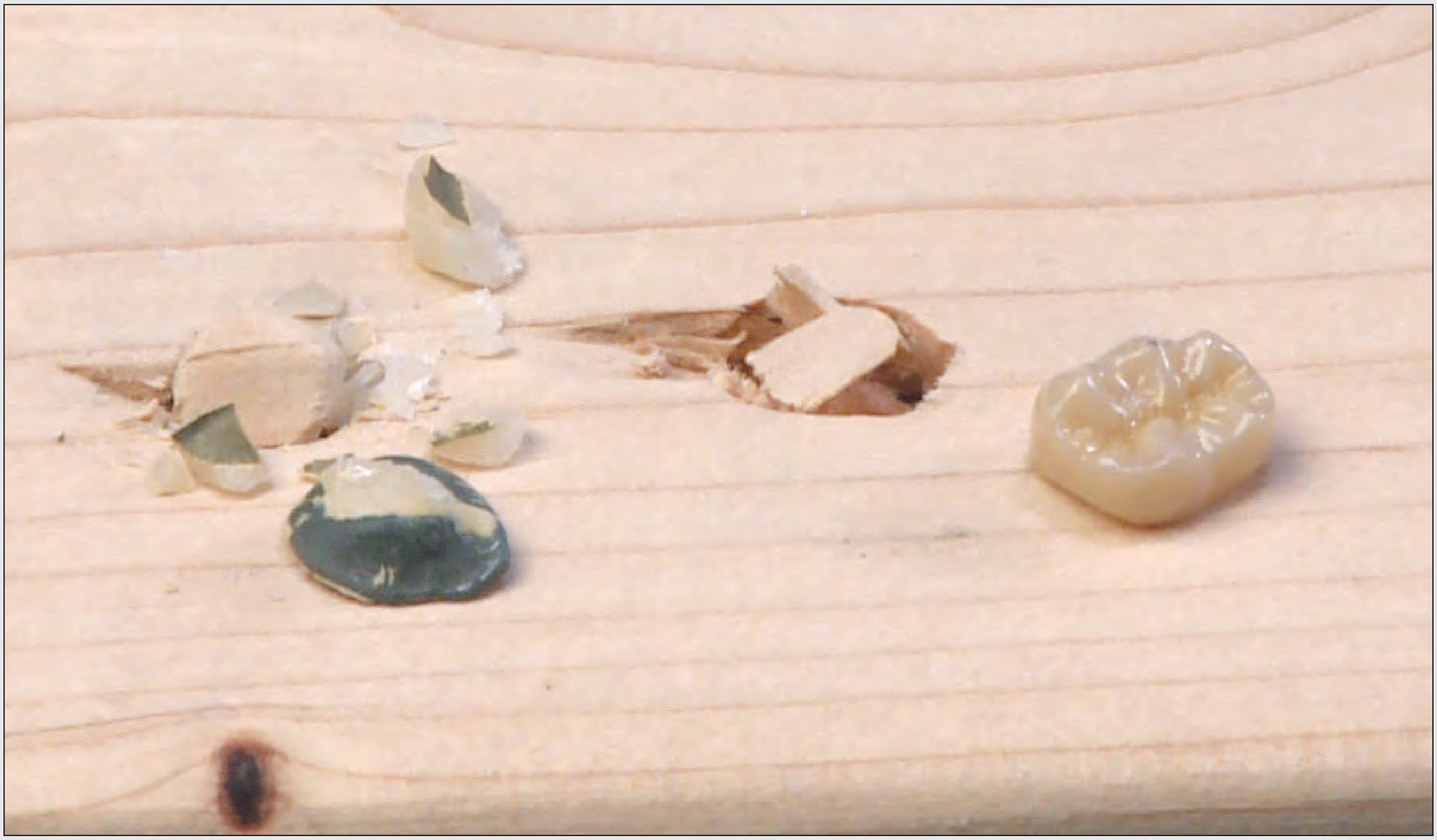

Figure 3: *Note the difference in the effect of a hammer striking a PFM crown and a BruxZir crown.*

If a material has a high value of fracture toughness (e.g., lead or steel), it will probably undergo ductile fracture. Brittle fracture, on the other hand, is very characteristic of most ceramic and glass-ceramic materials, which typically exhibit low and inconsistent fracture toughness.

Transformation toughening was a breakthrough in achieving high-strength ceramic materials that also had a high value for fracture toughness. For the first time, a ceramic material was available with an internal mechanism for actually inhibiting crack propagation. A crack in a traditional ceramic travels all the way through with little inhibition, resulting in immediate brittle fracture and catastrophic failure. The partially stabilized zirconia exhibits a fracture toughness that is three to six times higher than normal zirconia and most other ceramics; so tough, in fact, that it can be struck with a hammer, or even fabricated into a hammer for driving nails *(Fig. 3)*.

To achieve this toughness, the lab's scientists start with the purest materials available and, through size reduction and blending, promote better chemistry by refining the particulates. A green preform with very high pre-bisque firing density is then created, using unique consolidation processes that allow the smallest particulates to be as close as possible to each other before the machining starts (by doing this, the lab also reduces the elongation factor, which means a more accurate crown dimension). After machining, the part is sintered to full density, creating a material with a small grain size. If a crack moves through a material's grain boundaries, the material's grains deflect it. If a material has many grains to deflect and take energy out of the force of the crack, it becomes inherently stronger.

When this fracture toughness is combined with the third unique physical property of BruxZir Solid Zirconia — that of excellent resistance to thermal shock due to zirconia's low thermal expansion

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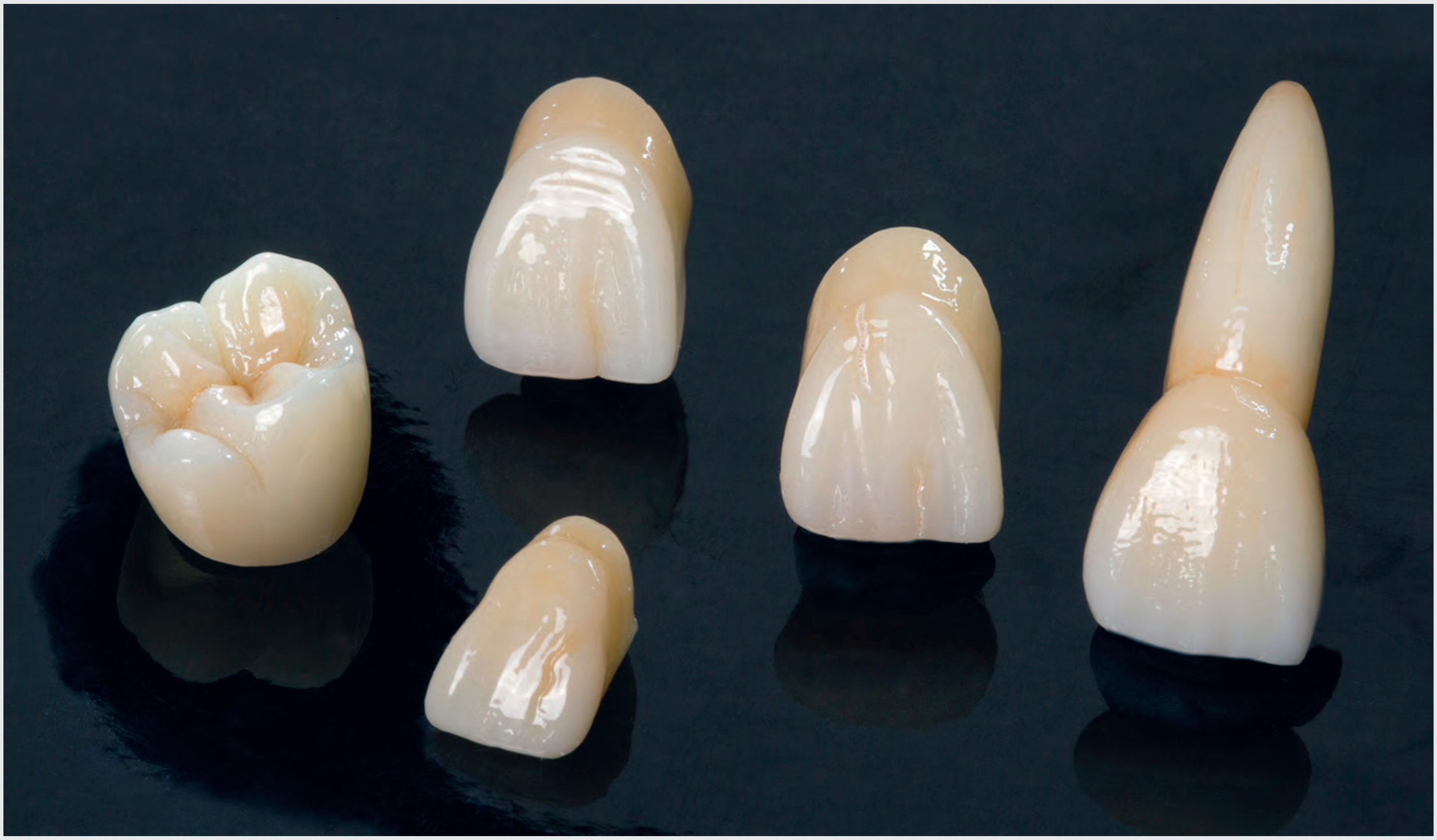

***Figure 4:** BruxZir restorations exhibit the warm, natural colors of the mouth.*

numbers — we are left with a restoration material that is very stable and wear-resistant in the mouth. In fact, in vitro studies on enamel wear have shown that diamond-polishing the BruxZir crown provides long-term life for opposing enamel surfaces as well.

These innovations make BruxZir Solid Zirconia an esthetic alternative to metal occlusal PFMs or cast-metal restorations for demanding situations like bruxers, implant restorations and areas with limited occlusal space. Designed and milled using CAD/CAM technology and then sintered for 2 hours at 1,530 degrees Celsius, the final BruxZir crown or bridge emerges nearly chip-proof.

However, it was the process of creating the strongest zirconia in the world that led to a zirconia with the innovative fourth and fifth properties: improved translucency and color. BruxZir Solid Zirconia has a higher translucency than other dental zirconias, particularly in the key wavelengths between 550–890 nanometers, the range representing the warm colors of the mouth that you want to transmit through the zirconia restoration *(Fig. 4)*. Plus, while zirconia has a natural opaque white hue, Glidewell Laboratories took note of advancements that arose from a by-product of the strengthening process that allow zirconia to be changed into a more desirable natural ivory shade — a shade much more lifelike than typical snow-white zirconia. This finding led to the development of BruxZir® Shaded 16 (Glidewell Laboratories; Newport Beach, Calif.).

The latest evolution in the industry-leading BruxZir product line, BruxZir Shaded 16 is a pre-shaded zirconia block for each of the 16 VITA Classical shades, with no color-dipping or staining required: literally a glaze-and-go system *(Fig. 5)*. The elimination of dipping and staining will greatly decrease case return rates due to

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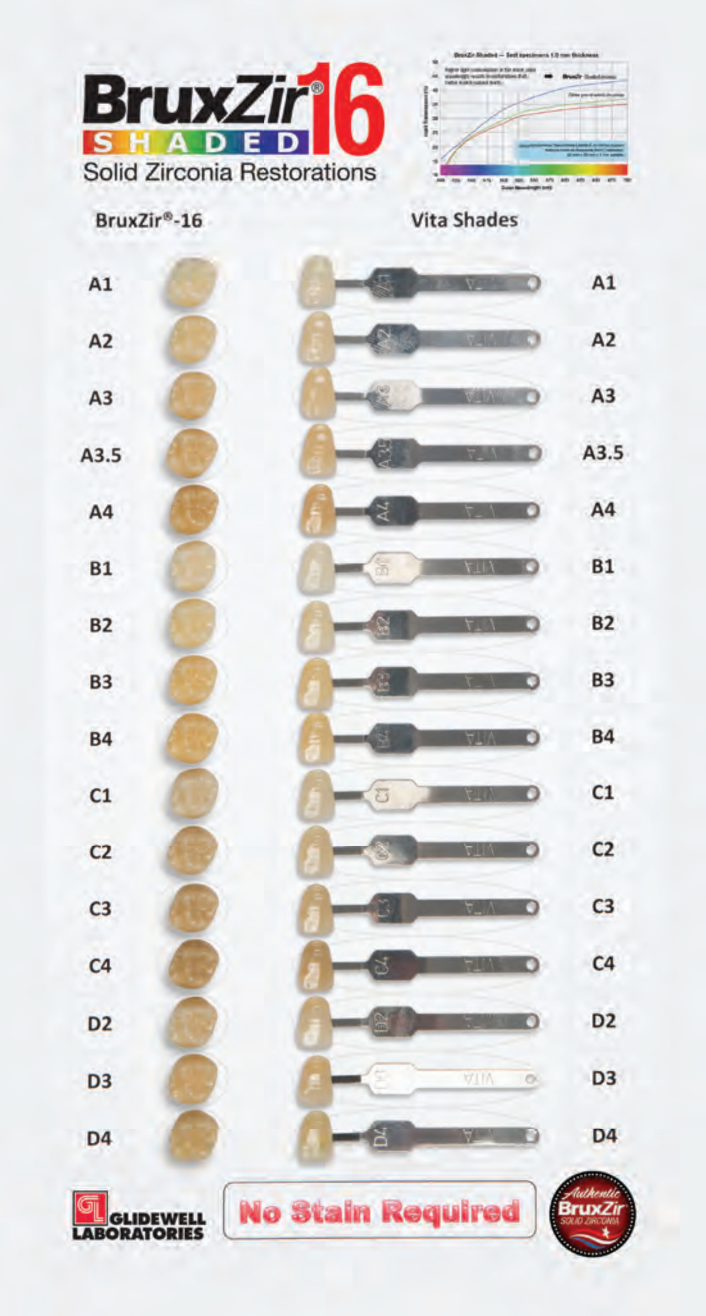

Figure 5: *BruxZir Shaded 16 is a pre-shaded zirconia block for each of the 16 VITA Classical shades.*

superior repeatability and a reduction of technician-dependent steps, and will also lower labor cost and improve the turnaround time for laboratory operations. Additionally, the development of this product opens up the possibility for chairside zirconia restorations in the coming years.

The addition of BruxZir Shaded 16 to the BruxZir family (the original BruxZir HT 2.0 and BruxZir Shaded, the series of four basic shaded compositions that let the ceramic technician add stain to the crown to establish final shade) will ensure that Glidewell Laboratories continues to offer class-leading zirconia compositions that suit every lab in the industry. Countless hours have been invested in the product's development to deliver color that matches all 16 VITA Classical shades, color consistency between all areas of the block, between blocks and between batches of blocks, no effect on the flexural strength or fracture toughness, and all while maintaining the translucency that has made BruxZir Solid Zirconia the most prescribed brand of full-contour zirconia. LP

> *"BruxZir Shaded 16 is a pre-shaded zirconia block for each of the 16 VITA Classical shades, with no color-dipping or staining required: literally a glaze-and-go system."*

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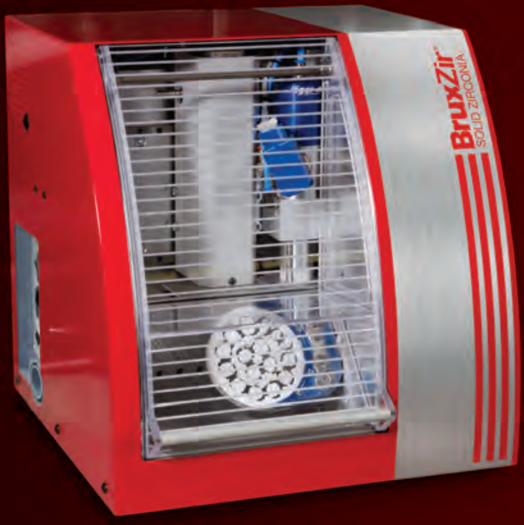

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One-on-ONE

Interview with Custom Automated Prosthetics

Interview of Rob Nazzal, CEO and Cofounder, and Bob Cohen, CDT, President and Cofounder

by Robin Bartolo, CDT, Glidewell Direct Sales Manager

interview of

Rob Nazzal, CEO *and*
Bob Cohen, CDT

Custom Automated Prosthetics is a company focused on aiding dental laboratories in transitioning toward digital design and manufacturing. Working with laboratories both large and small, the company's passion for dental technology is evident in its commitment to offering open solutions and avoiding the limiting contracts that are increasingly common from digital dentistry suppliers. Cofounded by Robert Nazzal and Bob Cohen, CDT, Custom Automated Prosthetics offers scanning, designing, and fabrication equipment and outsourcing services for customers who are looking to compete in the changing world of digital dentistry.

How did your company originally get involved in digital dentistry?

Rob Nazzal: I had some background in intraoral scanning with Brontes Technologies, which became the Lava™ C.O.S. (3M™ ESPE™; St. Paul, Minn.) when 3M acquired us. Bob had always been on the cutting edge of dental technology and had started to get into digital systems. Bob, I guess you started with Procera® (Nobel Biocare; Zurich, Switzerland)?

Bob Cohen: Yes, as early on as Procera, CEREC® (Sirona Dental Systems Inc.; Charlotte, N.C.) and then Lava.

Wow! You were the pioneer.

BC: I don't know if I was the pioneer, but I was in there. Let's just say that.

RN: Bob became involved in intraoral scanning systems, and we started working pretty closely together. We discovered that there was some need in the dental lab industry for digital, and we were two people with a deep knowledge of digital manufacturing: myself on the technical side and Bob on the dental technology side.

That sparked the birth of CAP, to address that emerging need. We saw a major shift happening rapidly in the industry, and with it, a lot of unknowns about how to get into digital technology. So we started up the company as a milling center, initially, and our mission sort of evolved from there.

That's fantastic, because that was one of the questions I wanted to ask both of you: What was the overall vision for starting Custom Automated Prosthetics? So the need for digital solutions in the dental laboratory sparked the union of two minds with different skill sets and brought them together. Can you expand on its start as a milling center and how it evolved beyond that spark?

RN: Sure. Back when we began in 2010, we saw that milling required pretty expensive machines and know-how to get the products produced digitally. So we started there for people who didn't have access to those kinds of funds or didn't have the volume of cases to justify making the products themselves. We started to see a couple of trends: The cost of the equipment started to come down and became much easier to use; at the same time, we were seeing increased demand for digitally designed restorations, either because the materials required it, or because the pricing and efficiency drove the industry toward digital processes. So through those trends, we saw a need to help customers get into scan-and-design systems themselves, not only to reduce their outsource cost, but also to give them more control and improve the turnaround speed. So we were a milling center, but we also offered scan-and-design systems like the 3Shape™ Scan & Design System (3Shape A/S; Copenhagen, Denmark).

From there, it was really the introduction of the Roland Mill (Roland DGA Corp.; Irvine, Calif.) that propelled our company into the next phase. We saw our customers moving up the chain with what they were able to do based on how accessible the equipment was. If you were doing two to three units of zirconia a day, the Roland machine could introduce a return on investment by allowing you to do your own fabrication pretty easily. So there was a real opportunity there to help people go to that next stage, and be able to fabricate, and take everything digitally into their own hands. That was a big shift for our company as well.

So the overall mission, as we took a step back while these dynamics were occurring, became helping labs through this digital transition. No matter where they're coming from, if they have nothing at all or if they already have some equipment and want to go to the next stage, we're here to help those laboratories move through the digital spectrum as they're ready to take each step forward.

You laid out a nice progression, from starting as a milling center, moving on to the scan-and-design options to get the laboratory involved in the CAD/CAM process, and then as the

cost of the equipment started to become more affordable, the introduction of the Roland Mill became another opportunity. Based on that interesting evolution, what would you say are the important issues facing dental laboratories that are expanding into digital manufacturing?

RN: I think the biggest issue is that there is so much availability. There's high-pressure sales from some companies to buy products from them; there are systems that are locked down — that is, pay short money for a mill or a scanner and send them your cases. Generally, when you really look deep into those business models, they work out to be less favorable to the customer. We've gone with the approach of just charging a fair price for what we're selling. We also provide top-notch support, and then leave the door open for laboratories to make best-in-class selections that fulfill their specific needs and the needs of their customers. In addition, we've gone ahead and kind of 'CAP-ified' just about all of our products, from adding a great anatomic library to 3Shape, to milling strategies that use tiny tools to get that anatomical detail in a milled full-contour BruxZir® crown (Glidewell Laboratories; Newport Beach, Calif.). Things of that nature.

Would you agree that there is a lot of confusion out there? That it's important to have a credible source for those laboratories that are thinking about getting into this new world — a place where they can get straight answers that are going to help them, as opposed to adding to the confusion? We certainly deal with that on our end when we interact with our customers.

BC: Yes, there's no question that's a factor. There are companies out there that are selling stuff so inexpensively, but locking up laboratories in the process. And in the end, if you look at the 5-year return-on-investment analysis, it's costing them a lot more for what apparently looked less expensive up front.

Yes, some of these deals appear too good to be true, and it's kind of hard at the initial part of the conversation — before you've established a connection — to show the value of doing it a different way. Or sometimes the conversation does take place, but it's after the purchase has been made.

RN: Correct.

Can you give me a typical example of the progression for a dental laboratory that partners with you? Does it follow the line that you explained to us, where they start by outsourcing some cases for you to mill? Or do they come your way from a multitude of different avenues?

BC: It's really a multitude of different avenues. We'll start by milling for some customers, and then they'll decide they want to do their own design. Some will pick up a scanner from us, and we'll see that they're doing a lot of work, and they'll talk to us about purchasing a mill. Perhaps they may come to us and already have many scanners, many mills, and want a custom abutment solution, so we'll just provide that. So the customers are popping in at any point and any level.

It's nice that you offer the full circle of solutions and 'CAP-ified' systems so they have a source that they can go to. What would you say the percentage breakdown in your business is between outsource restorations from other laboratories and scanning and milling equipment and material sales?

RN: I think we're about two-to-one heavy on the equipment and materials. At one time, it was 100 percent for the milling center side.

That's a big transition!

BC: The evolution is really interesting. In the first six months when we started, we were 97 percent model-based at the milling center. Now it's more like 50-50 in the milling center, files versus models, and equipment and materials have taken over. Everything coming from the laboratories is moving toward more in-house and digital-based work. The trend has been hitting a hockey-stick-type curve in the last couple of years.

That's fascinating. I didn't expect the split to be that dramatic. As we touch on the fact that the equipment and materials are such a big part of your business now, can you describe the advantages of each of the three brands of full-contour zirconia, and what leads you to have all three options available in your portfolio of products?

BC: We sell what I would describe as the number one name

brand in zirconia, which is BruxZir Solid Zirconia. There are a lot of people wanting BruxZir restorations: both dentists writing "BruxZir" on the Rxs, and laboratories either wanting to fill those Rxs or wanting to capitalize on the BruxZir name brand and all the advertising that you guys have done so well. So we carry that product.

We carry our own branded, FDA-cleared zirconia, which we call CAP FZ (Custom Automated Prosthetics; Stoneham, Mass.), and then as a framework material, CAP QZ. It's a white material where we have worked out a multi-shading process in the green state, and we've passed that on to our customers. That's a high-selling product for us.

Then recently we picked up a more economical brand, which is Sagemax® (Sagemax Bioceramics Inc.; Federal Way, Wash.), and that's for the economically conscious laboratory.

Would it be fair to say that you offer this variety because you have many customers with different mills and different products, and you want to be the one-stop shop?

BC: Yes, definitely. We started out by selling just CAP FZ , but we found that it was too expensive for some customers. There were some customers that wanted to sell $79 crowns with five dollars worth of zirconia material in the crown, and FZ just didn't do that. So we felt we needed a less expensive material. Also, you guys came along with the technology for pre-shading. We had learned how to do the multi-shading, and a lot of our laboratories had picked it up as well, but for others, it has been problematic. The pre-shade has been very nice and has had a lot of further advantages as well. For example, when heavy adjustment is done, you don't have this white spot exposed.

Right, and I'm sure most of the technical questions involved the dipping solutions or that multi-layered approach that you've taught your partners, which can be ripe for potential inconsistencies if the procedure is not followed to the letter or if the protocol is adjusted.

BC: It truly introduces the potential for error, whereas going with pre-shaded, you pretty much know what you're going to get every time when it comes out of the oven.

That has certainly been our experience as well with BruxZir Solid Zirconia; it has been a great product addition to the line. Most labs feel the same way. Its predictable and, as you stated very well, if there is a need to make an adjustment, it's not going to be a concern that any show-through is going to be visible. So it's good to hear that you're experiencing the same benefits with that pre-shaded approach.

RN: Definitely. So that's the primary reason we have three options.

Looking to the future, what kind of new products or services do you plan on introducing to your partner laboratories?

BC: We want to drive primarily toward implants at this point. We've recently launched Izir (Custom Automated Prosthetics), which is a full-contour, screw-retained, hybrid-like restoration. It's a replacement prosthesis for the conventional cast-metal framework where you have denture teeth processed with denture acrylic to a bar. We're doing that now with full-contour zirconia.

So you color the tissue, it's monolithic and has a few connections to the implant?

BC: There is a little bit of porcelain application, which would just be for the pink. We're unable to get the zirconia to look like soft tissue without a pink porcelain application. Other than that, it's pretty much all automated.

There are some real advantages to it. As you know, once you automate something, you have a digital file, so if there's ever a problem with a case, you can just pull up the file any time and remanufacture it. Whereas, we've been involved in implants for over 30 years, and when some of these cases have worn out, it's truly like starting the case all over again when you remake them. If you do it digitally, 10 years, 20, 30 years from now, if we have that digital file, we can remake the case just by putting in the milling material.

Especially with the implants, they would have a tendency to still be in the same place. There wouldn't be too many changes.

So the ability to save the file and revisit it later on and just make the required modification, as opposed to starting all over again, is a nice add-on.

RN: Right. The thing that we're most excited about with this particular product is that this is some of the most sophisticated dentistry that can be done. And it can be done with equipment that is very accessible to your average laboratory these days. It's exciting to help the labs that work with us to be able to compete at a level that allows them to elevate their offering to the better, cheaper, faster options that people are looking for. It's a superior product that is much stronger than the alternatives, and not prone to some of their issues.

The ability to control the process in-house as opposed to sending it out, I believe, is another big advantage.

RN: Definitely.

BC: Especially for such complex types of cases. You need to close the loop as quickly as possible on them.

RN: It works much better as an in-house product than as an outsourced product because these cases, during manufacturing, generally require some conversations with the restorative dentist. So when you outsource it, you're a step away, and it's a more difficult communication.

And once it's sintered, it's hard to change it.

BC: Right.

RN: What we actually do is we go ahead and do the full design. Then as a mandatory step, rather then producing a zirconia restoration, we mill a PMMA version, which we call a CAD verification bridge. That goes to the doctor and it's tried in the mouth first. The next step is to check every aspect of the case, from the vertical opening to the accuracy of the model and the scan data, phonetics, hygienics, occlusion, just everything. Then, if it goes well, the patient can wear it as a temp.

Perfect. That's a great solution. Now speaking of implants, you've started working with Glidewell custom abutment blanks. What were some of the advantages that you saw from that product offering?

RN: One of the nice things about working with Glidewell Laboratories in general is that you guys are very easy to do business with. Knowing that you have such an extensive and mature custom abutment offering is very attractive to us, and allows us that peace of mind that we will be working with the same starting product that you work with in your own milling center. That was excellent for us. And the product meets a lot of the requirements:

It's very well thought-through in terms of its design and sizes, and it's excellently optimized for speed. It allows ultimate flexibility in the design of the custom abutment, and it's priced right. Basically, it meets all of the key requirements.

That's great to hear.

RN: We had started with you on the BruxZir side, so it was a very logical next step to approach you, and we were honored to be the first reseller of the product.

You were indeed the first company that we opened that option to as you have the implant knowledge and the milling know-how. As you already have such a well-established group of laboratories that you've worked with, that you've set up with mills, we knew you would also be able to provide them with the milling strategies to handle the blank and produce a great custom abutment. So we believed this would be a good partnership.

RN: It has been a wonderful opportunity to collaborate with you guys. Our organization is designed to support people at all levels — small labs and large labs alike. We have some two-man labs that we work with, and we have some of the largest labs in the country as well.

And I think that's a great point to reinforce to customers looking for a solution that's all-inclusive. They want one place they can go to get the answers they need and the support they need. Thank you so much! LP

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Lab INDUSTRY UPDATE

Wilma R. Peterson, 2014 CDT of the Year

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CDT

Wilma Peterson of Glidewell Laboratories has been awarded the prestigious CDT of the Year Award for 2014 from the National Board for Certification in Dental Laboratory Technology (NBC). What's more, she is the first woman to receive such an honor.

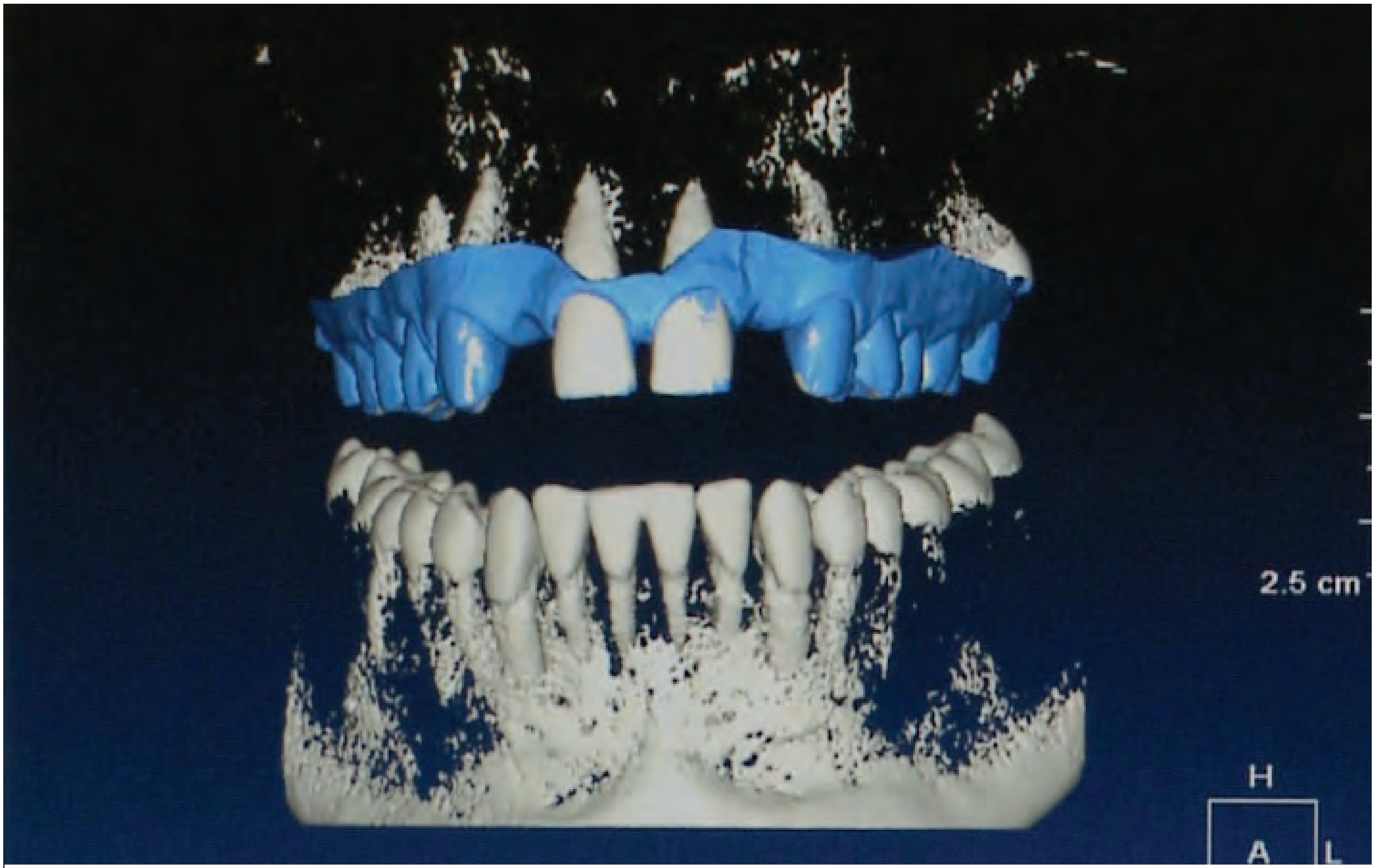
Wilma's career in the dental laboratory spans over 50 years. She became a Certified Dental Technician specializing in ceramics in 1971, and has maintained her certification for over four decades. As the current manager of education at Glidewell Laboratories, she trains technicians in both day-to-day procedure and in general administration of full-service dental laboratories. In addition, she hosts the written and practical exams, or CDT pilot tests, given annually to certify technicians.

As an active member of the industry, she founded two dental technology schools in the Philippines while living abroad, and coauthored the book *Essential Guide to Prosthodontic Laboratory Procedure*. In 2012, she was honored as one of the Top 25 Women in Dentistry from *Dental Products Report* magazine.

Always committed to community service, Wilma has volunteered countless hours around the world in an effort to bring quality dental treatment to those unable to afford it. However, Wilma's dedication to dentistry isn't confined to her own species: In 2009, she began the Feathered Friends Foundation to address the needs of birds and numerous endangered species. Through this foundation, she has fabricated a variety of dental prostheses for animals, including beaks for birds and crowns for jaguars.

For Peterson, helping students find the right occupational fit to suit their interests and strengths is an important and rewarding part of her career, and she looks forward in the future to sharing her wealth of knowledge with young people interested in becoming dental technicians.

Glidewell Laboratories is extremely proud to assist Wilma in her mission of creating a welcoming environment with a patient-centered focus. Working together, we hope to continue building careers and expanding to more individuals the opportunities available throughout the lab industry.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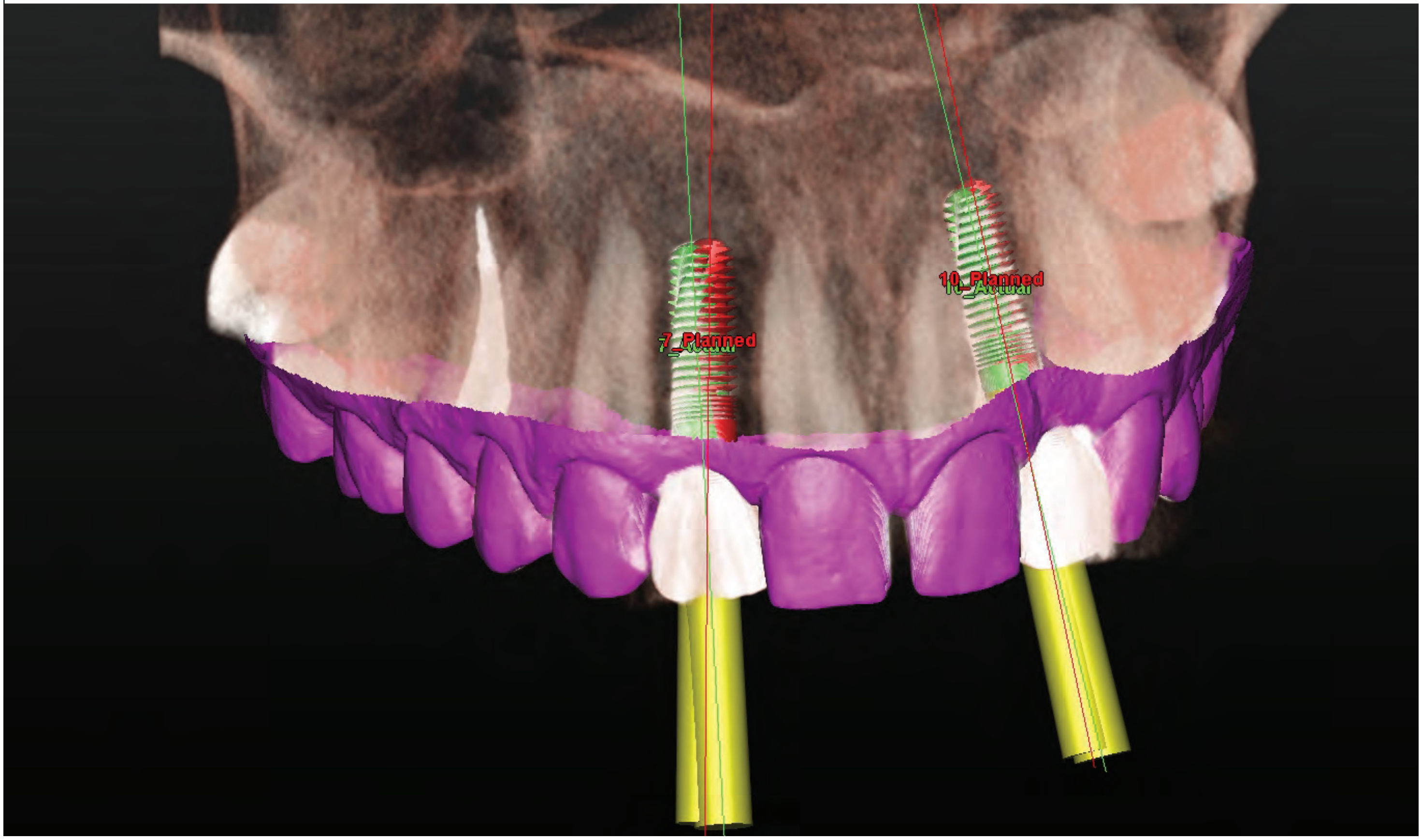
10_Planned
10_Actual
7_Planned
7_Actual

A COMPREHENSIVE Digital APPROACH

To Implant Dentistry

article by

Siamak Abai *and*
Zach Dalmau

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Accounting for anatomical limitations and restorative goals while placing implants is a clinical necessity, as placement without such considerations can potentially compromise the success of function and esthetics in the case. Modern digital treatment planning (DTP) technology advances the diagnostic phase of implantology by enabling the clinician, in partnership with a trained design specialist, to plan the surgery and clearly visualize patient anatomy in a virtual environment prior to implant placement. The result is a precise, restoratively driven treatment plan.

In DTP, intraoral scans and cone-beam computed tomography (CBCT) data of the patient's anatomy and edentulous spaces are used to produce a digital model, which in turn drives the design and placement of the surgical and restorative components. To reconcile the application of this virtual data to clinical practice, stereolithographic (SLA) surgical guides are used to direct the implant into the exact, patient-specific location. The information gained through DTP allows the clinician a highly detailed view of the case, enabling ideal positioning for maximum support and strength.

Capturing Subsurface Anatomy with CBCT Technology

For years, dentistry has relied on standard periapical radiographic survey and physical incisions to ascertain root and bone structure. Technological advancements in digital imaging have provided clinicians with more accurate and detailed assessment tools. Specifically, the widespread availability of cone-beam computed tomography scanners in both imaging centers and clinical settings allows dentists a more complete view of the area of implantation. CBCT scanners capture numerous volumes of intersecting planes of data throughout the maxillofacial area, which are then used to create a three-dimensional image of the area of implantation and underlying structure *(Fig. 1)*.

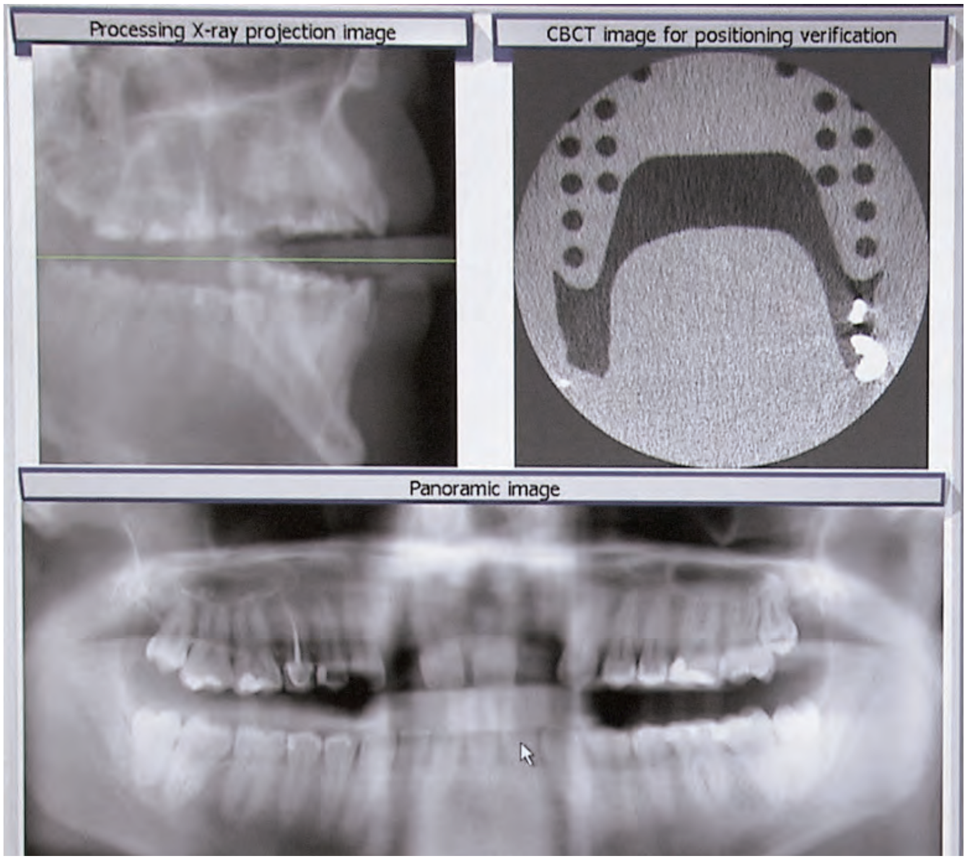

Processing X-ray projection image
CBCT image for positioning verification
Panoramic image

***Figure 1:** Screen view of the series of images created with a CBCT scanner.*

With this type of imagery, clinicians can visualize the bone available for implant placement, review the soft-tissue thickness, and locate the maxillary sinuses and vital structures of the mandibular canal. The advantage of these systems is that surgeons can plan an implant position and inclination with a much higher degree of accuracy. With the data obtained, surgical placement of dental implants can be done in a conventional freehand manner using the clinician's diagnosis; however, a significant benefit of the CBCT data is that it can be brought into digital treatment planning software for further practical support.

CBCT scanners output their image data in the Digital Imaging and Communications in Medicine (DICOM) file format. This file type is an industry standard that enables scanning systems and surgical software to communicate, regardless of manufacturer. Due to the universal nature of the format, error in transferring data between CBCT scanners and surgical software is minimal because there is no need to translate or transform the data. With the images captured and transferred to the design laboratory, the design specialist can view the CBCT DICOM data utilizing surgical software that allows the manipulation of imagery in a three-dimensional environment *(Fig. 2)*.

> *“As the amount of accuracy achieved in guided surgery is directly related to the clarity of the initial impression, intraoral impression systems are tailor-made for guided surgery.”*

Capturing the Surface Anatomy

As the amount of accuracy achieved in guided surgery is directly related to the clarity of the initial impression, intraoral impression systems are tailor-made for guided surgery. Intraoral impression systems capture the surface anatomy in the stereolithography (STL) file format. These files reconstruct 3-D surfaces and shapes by creating a mesh of miniscule interconnected triangles.

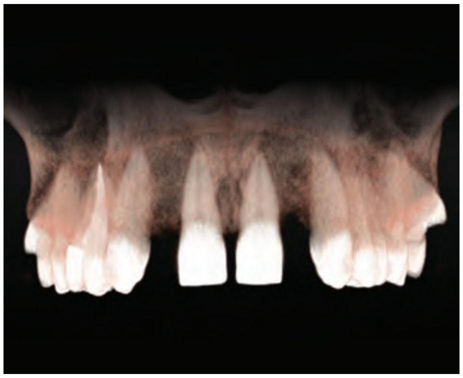


Figure 2: *The CBCT file represented in a 3-D environment.*

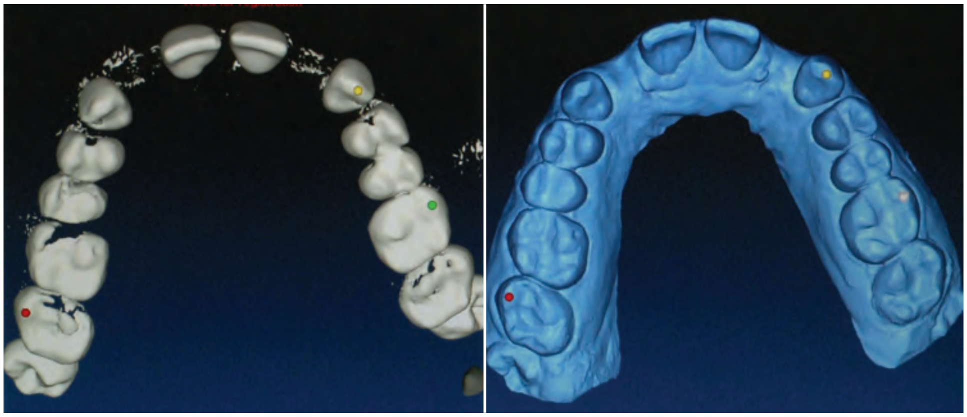


Figure 3: *The design software requires the operator to align the two files by selecting matching points.*

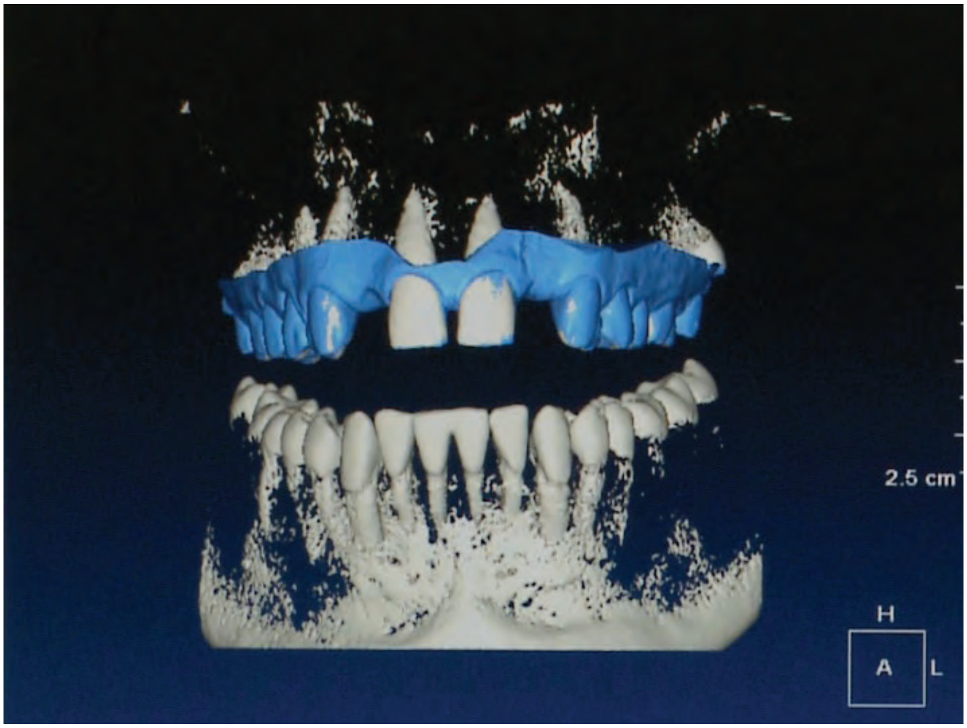


Figure 4: *Merging of the CBCT DICOM file and the intraoral scan STL file, highlighting the additional subsurface anatomy represented by the scan.*

Merging the DICOM and STL Files

Once the CBCT data is imported into the surgical software, the clinician can begin the process of merging the two distinct files. The CBCT DICOM data, although representing a three-dimensional space, does not actually contain information regarding the dentition's 3-D surface texture. The treatment planning software allows the operator to outline and segment the teeth and tissue to create this surface data. To ensure that the designer has the most accurate surface information for fabrication of the surgical guide, the surface texture from the STL intraoral scan file is merged to the CBCT DICOM data. At the merge step, the treatment planning software requires the operator to select at least three matching points on both sets of the 3-D data. These points are used to overlap the surface data from the CBCT file and the surface data from the intraoral impression system, thereby aligning the sets of data in the same orientation in three-dimensional CAD space *(Fig. 3)*.

The data contained in the CBCT file and the data contained in the STL file are distinctly separate. However, the industry has termed the files as "merged" because they are aligned to the exact same dimensions and orientation in a singular 3-D space. This is represented in the surgical software by showing the STL data laid over the DICOM data, creating what appears to be a complete, comprehensive model that contains both the surface and subsurface anatomy *(Fig. 4)*. After this step, the design specialist is able to aid in planning the surgery by utilizing the merged three-dimensional anatomical model *(Fig. 5)*.

Digital Treatment Planning

Within this model, the technician can plan and digitally place an implant designed specifically for the proposed final prosthesis. With current generation planning software, the technician can propose a perfectly esthetic prosthesis that suits the patient-specific requirements of the case *(Fig. 6)*. When the restorations are placed in the ideal position, an implant support structure is designed to facilitate that exact prosthetic outcome *(Fig. 7)*. A significant benefit of the software is the ability to precisely measure areas within the mouth, ensuring that the implant is positioned within the correct parameters to promote soft-tissue healing, as well as growth of the papillae. This data can also be used to create patient-specific healing and provisional components.

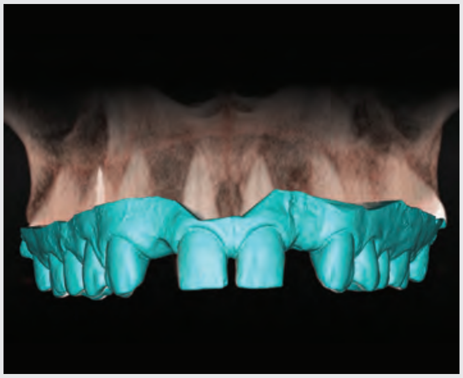


***Figure 5:** The final merged file.*

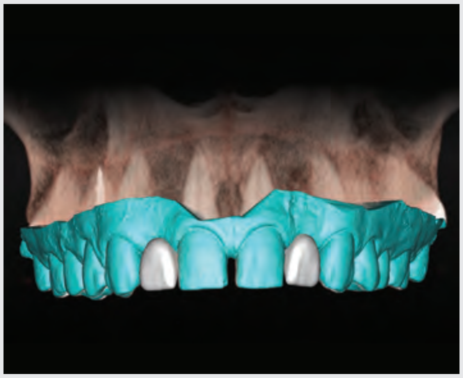


***Figure 6:** The digital proposal of the two anterior prostheses.*

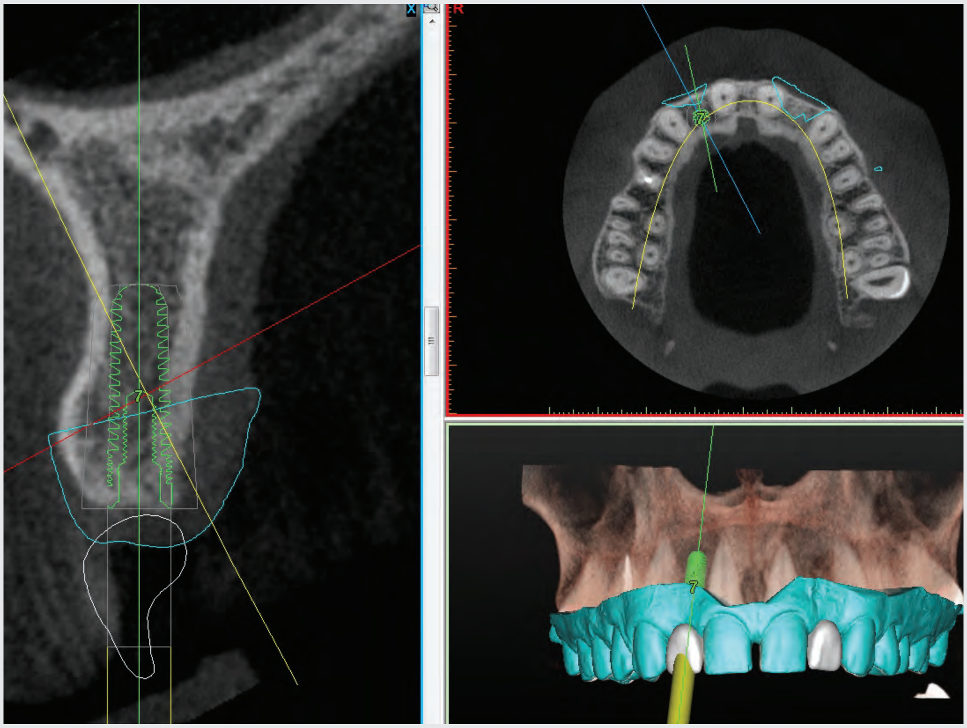


***Figure 7:** The digital placement of the first implant, showing the level of dimensional accuracy that can be achieved with digital treatment planning software.*

> *"To ensure that the designer has the most accurate surface information for the fabrication of the surgical guide, the surface texture from the STL intraoral scan file is merged to the CBCT DICOM data."*

Creating the Surgical Guide

Although the digital treatment planning phase requires additional preparatory steps prior to surgery, clinicians who utilize digital treatment planning services are rewarded with the option to perform the surgery in a fully guided manner. As all of the necessary data has been captured, created and adjusted, the new STL file contains both the surface anatomy of the dentition and the ideal position of the implant. From this file, the surgical guide is designed with features that will seat it firmly in the proper orientation for its metal sleeve to steer the drilling and placement process, ensuring precise situation of the implant *(Fig. 8)*. With the design finished, the surgical guide STL file is sent to a 3-D printer for fabrication.

Surgery

By the time of the surgery presented in this article, DTP had eliminated many of the possible unknowns. From the previously constructed data sets, a tooth-supported guide was fabricated. Viewing windows were incorporated, allowing the position of the guide to be assessed in order to ensure that it was fully seated. A tissue punch was placed through the metal drill sleeves to remove soft tissue at the implant sites, establishing access to the cortical plate so the osteotomies and site preparation could proceed. This case utilized two 3.7 mm x 13 mm Inclusive® Tapered Implants (Glidewell Direct; Irvine, Calif.). A series of Inclusive Surgical Drills, ending with the Ø2.8/2.3 mm drill, was used along with the incorporated sleeves of the surgical guide to perform the osteotomies. Both implants were placed through the surgical guide and seated into the maxilla *(Fig. 9)*. In order to ensure the final screw-retained restorations from the laboratory would be properly aligned with the placed implants, the flat ends of the implants' coronal internal hexes were oriented parallel with the facial wall of the anterior zone upon final seating *(Fig. 10)*.

With the implants in place, their stability was measured to evaluate the possibility of immediate loading using the Osstell® ISQ implant stability meter (Osstell USA; Linthicum, Md.). This device uses reso-

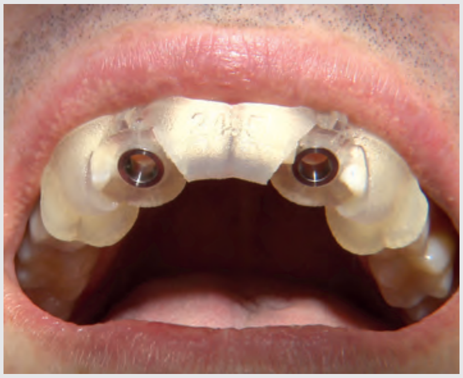


Figure 8: *The stereolithography-printed surgical guide, ready for use.*

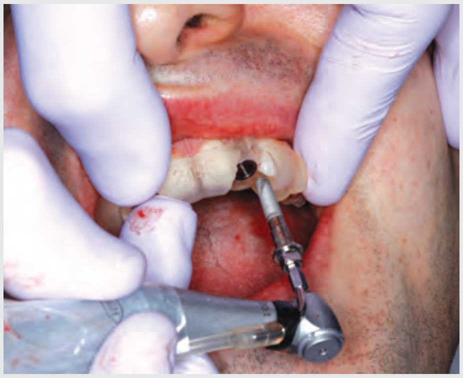


Figure 9: *Implant placement using a handpiece and the surgical guide.*

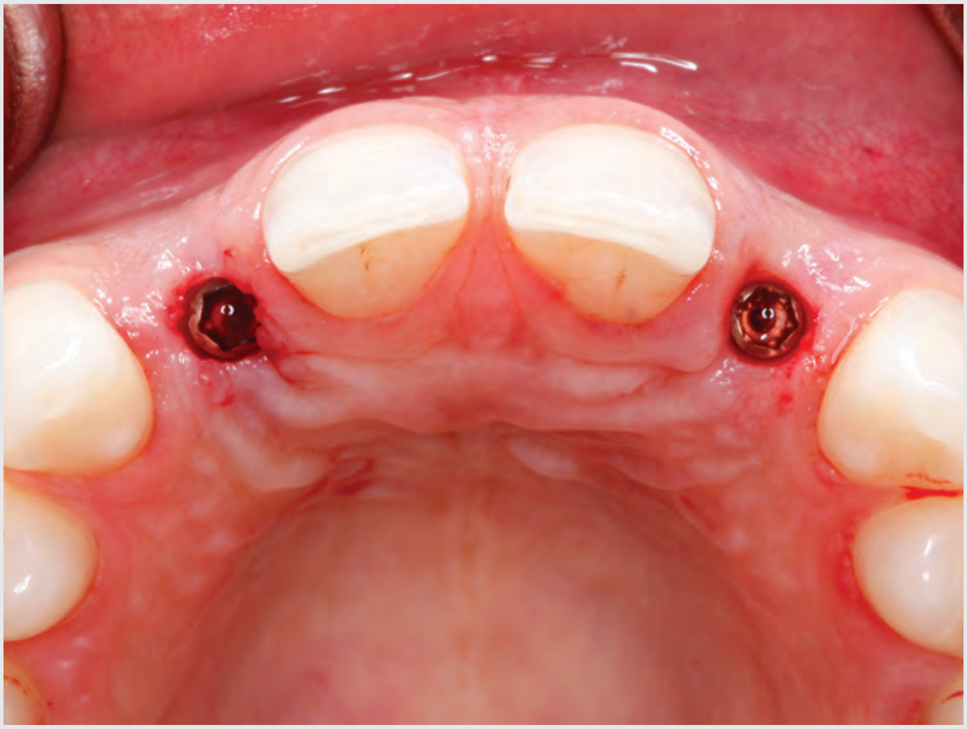


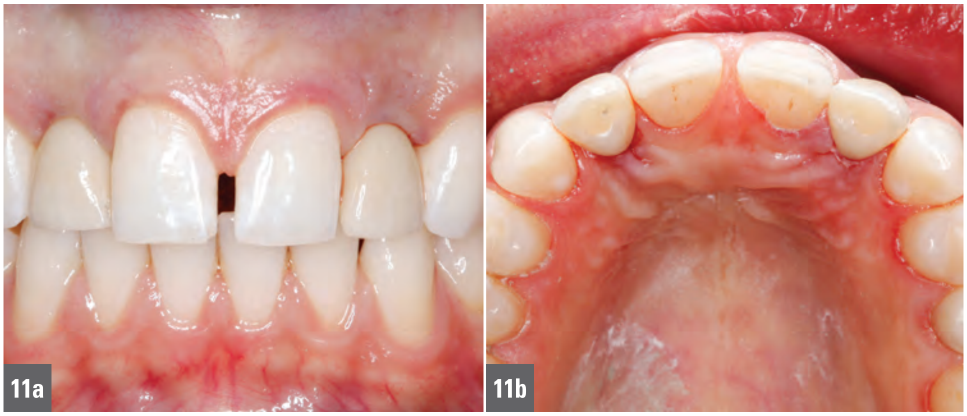
Figure 10: *Orientation of the internal hex connections with the flat sides parallel to the facial wall.*

> *"The surgical guide is designed with features that will seat it firmly in the proper orientation for its metal sleeve to steer the drilling and placement process, ensuring precise situation of the implant."*

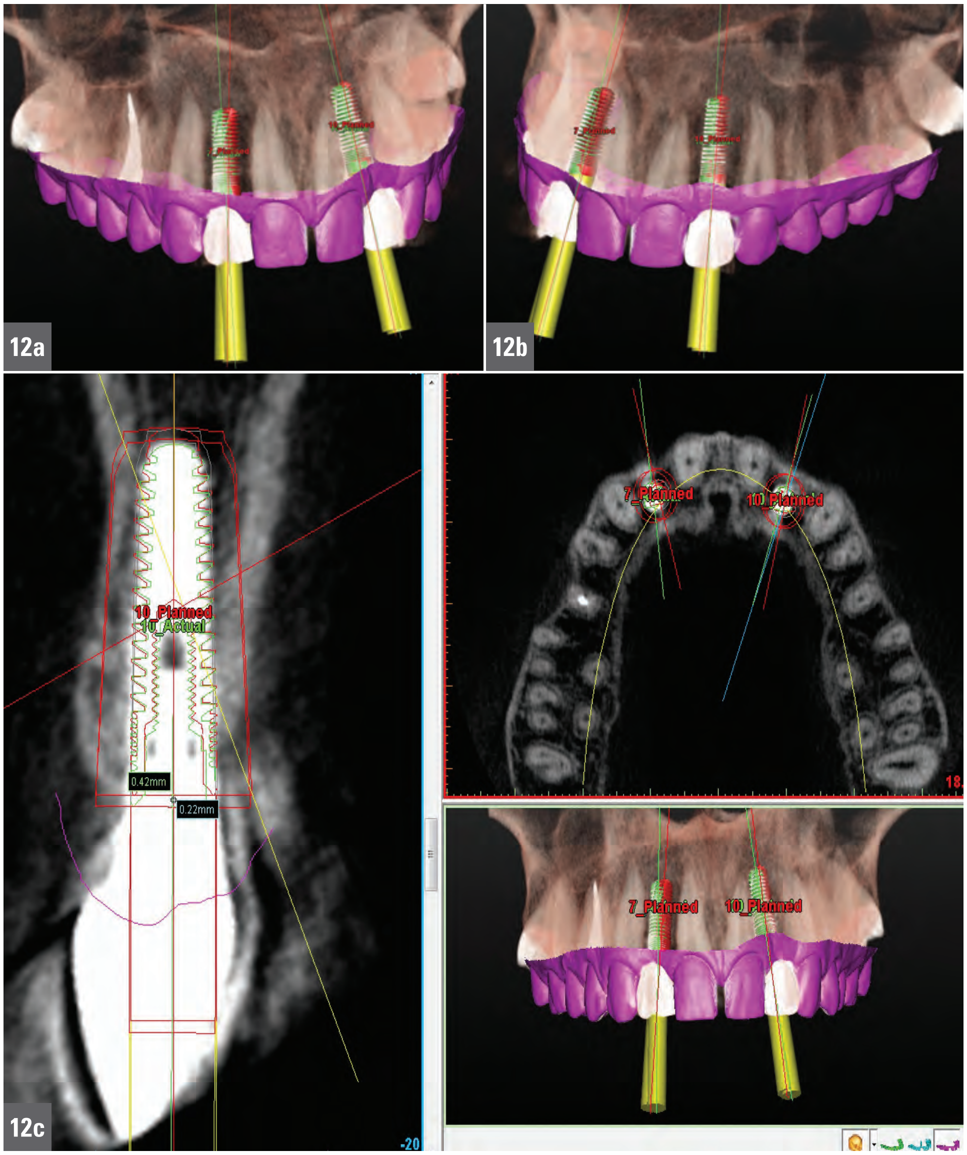
nance frequency analysis to determine the structural soundness of a seated implant. The device's measurement probe causes the SmartPeg™ attachment (Osstell USA) — a precision-crafted metal rod that is loaded into the implant's coronal hex — to resonate. The device calculates the initial stability of the implant by measuring the resonating frequency of the peg and comparing it against predetermined values. The machine then displays a number on the Implant Stability Quotient (ISQ) scale, with numbers closer to 100 depicting greater stability. For this case, both implant sites produced values, which, along with the occlusal design of the restorations, would allow for immediate loading.

Taking all the available information into account, the final restorations were delivered at the time of implant placement. Due to the proper axial orientation of the implants, the need for angle-correcting custom healing abutments and cement-retained restorations was eliminated, allowing for the use of screw-retained BruxZir® Solid Zirconia crowns (Glidewell Laboratories; Newport Beach, Calif.). Teflon tape was placed in the area of the screw access holes, which were then sealed with packable composite. The case was treatment planned, and the implant crowns were positioned to promote growth of the papillae. The immediate results were determined to be esthetically pleasing *(Figs. 11a, 11b)*.

Upon completion of the surgical phase, the pretreatment data was compared against the postsurgical data. For the purposes of this study, a post-treatment CBCT scan was taken following surgery. In the case of tooth #7 and #10, the implants were placed very close to the cortical wall so a driver tool could be used to access the area behind the incisal edge of the final screw-retained restorations. Utilizing implant planning software to examine the case, an overlapping comparison of the data was created, with the pre-existing plan displayed in red and the positions of the actual implants colored in green *(Figs. 12a–12c)*. The software allowed for measurement of the discrepancy between the planned and placed implant



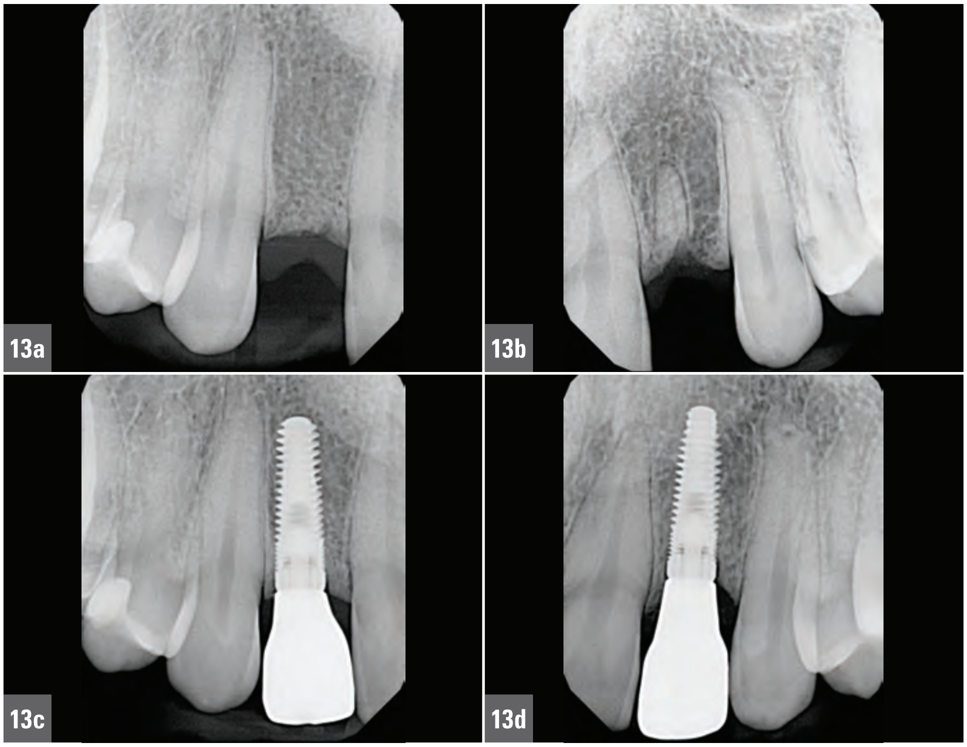
Figures 11a, 11b: *Screw-retained BruxZir crowns in place, delivered immediately following placement of the implants.*



Figures 12a–12c: *Overlay of presurgical planning and postsurgical images of the area of implantation. The red represents the planned, and the green represents the actual implant placement.*

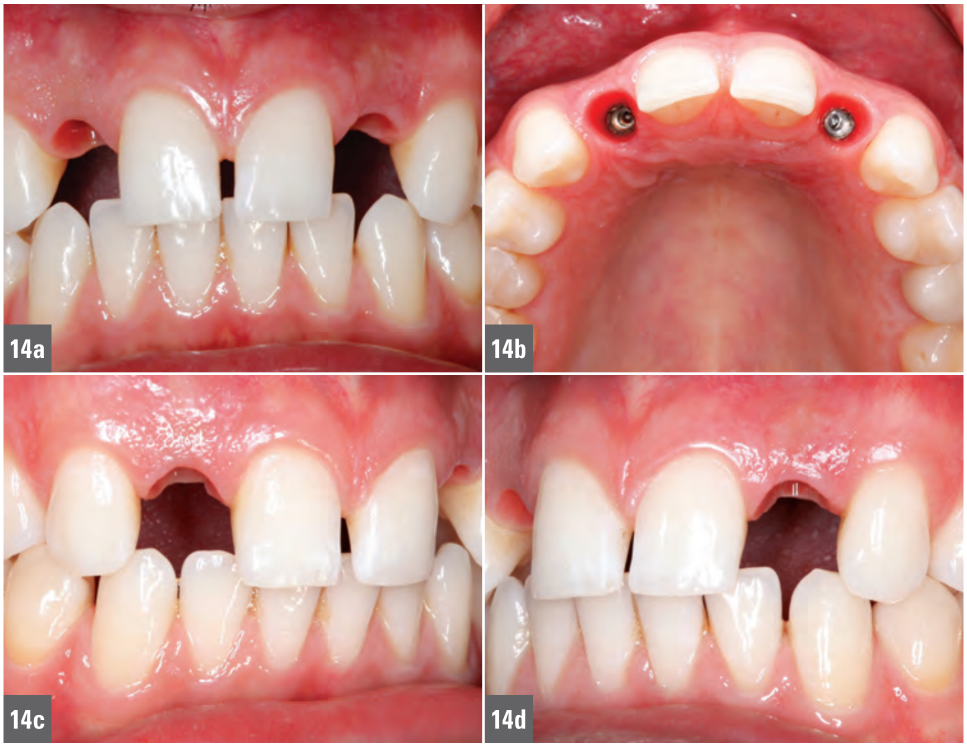
positions, which was less than 0.4 mm in both cases, indicating that there were no issues with fit during placement of the final screw-retained crowns. Surgeries led by DTP deliver a noticeable improvement over traditional implantation in terms of predictability and case success. This is a result of the increased accuracy gained from the coupling of CAD/CAM technology with CBCT and intraoral scanning.

The degree of accuracy with which the implants in this case were placed resulted in superb restorations in terms of esthetics and function. A comparison of the preoperative and postoperative radiographs highlights the success of the surgery *(Figs. 13a–13d)*. At a follow-up appointment four months post-delivery, the patient returned to the operatory so the final restorations could be removed to evaluate the success of tissue contouring in the case *(Figs. 14a–14d)*. The accuracy gained through guided surgery maintained the interproximal spaces between the implants and the adjacent roots, encouraging the growth of the interproximal papillae and making for a highly esthetic case outcome *(Figs. 15a–15e)*.



Figures 13a–13d: *Pre-extraction and post-delivery radiographs of the case.*

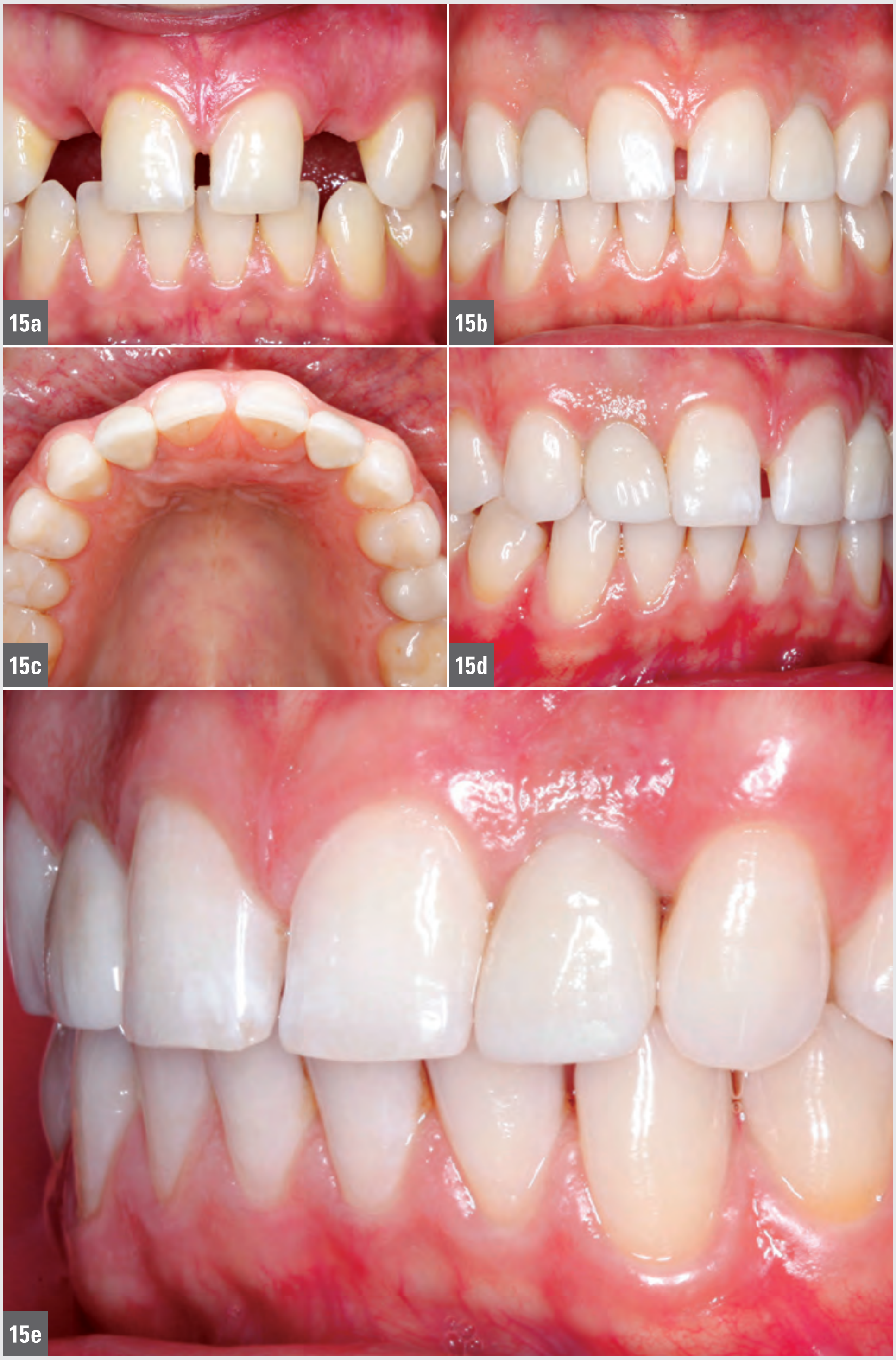
> “Surgeries led by digital treatment planning deliver a noticeable improvement over traditional implantation in terms of predictability and case success.”



Figures 14a–14d: *Four-month postsurgical removal of final screw-retained prostheses. Note the natural tissue contours resulting in part from the ideal positioning of the implants.*

Conclusion

In terms of consistency and predictability, restorations produced by laboratories incorporating the digital treatment planning process have a noticeable improvement over traditionally created implant prostheses, enabling dental technicians and clinicians to guarantee a heightened level of quality and case success.



Figures 15a–15e: *Comparison of the before (15a) and after (15b) facial views, as well as the occlusal (15c) and lateral views (15d, 15e) of the finished arch.*

Raising THE BAR:

Inclusive® CAD/CAM Milled Bar Technology

Cast-metal bars have traditionally been used in fixed-removable implant cases when indicated, as a solution to increase the strength of the acrylic prosthesis and more evenly distribute load-bearing forces across the implants themselves. Given these important benefits, bars are often prescribed by clinicians in full-arch cases unless contraindicated by limited vertical dimension or inadequate patient finances. Traditional casting methods, however, can be time-consuming and cost-intensive, relying heavily on inexact processes that often result in multiple try-in appointments or structural flaws within the bar itself. Fortunately, advances in CAD/CAM technology have brought about communication tools and production techniques that are faster and more precise, increasing the efficiency with which implant bars are fabricated and greatly improving predictability upon seating. Streamlined workflows consisting of proven processes serve to mitigate human error and reduce the learning curve for clinicians and lab technicians working together to restore edentulous cases. The overall process serves to minimize or even eliminate repeat try-ins, reducing clinician costs. Moreover, the high-quality titanium alloy from which CAD/CAM bars are milled results in a one-piece framework that is both lighter and stronger, increasing patient comfort and confidence.

article by

Dzevad Ceranic

Dzevad Ceranic, CDT, is vice president of lab operations at Glidewell Laboratories and spearheaded the company's rapid implant growth.

A Passive Fit

Perhaps the clearest advantage of utilizing CAD/CAM technology in the production of implant bars and frameworks is the superior fit of the bar. Traditional casting methods are imprecise, highly technique-sensitive and costly. To ensure a passive fit during try-in, a cast metal implant bar is typically delivered in segments, attached to the individual implants in the patient's mouth and luted together intraorally. The united framework is then picked up in an impression and returned to a lab, where the segments are laser-welded together *(Fig. 1)* for a second try-in.

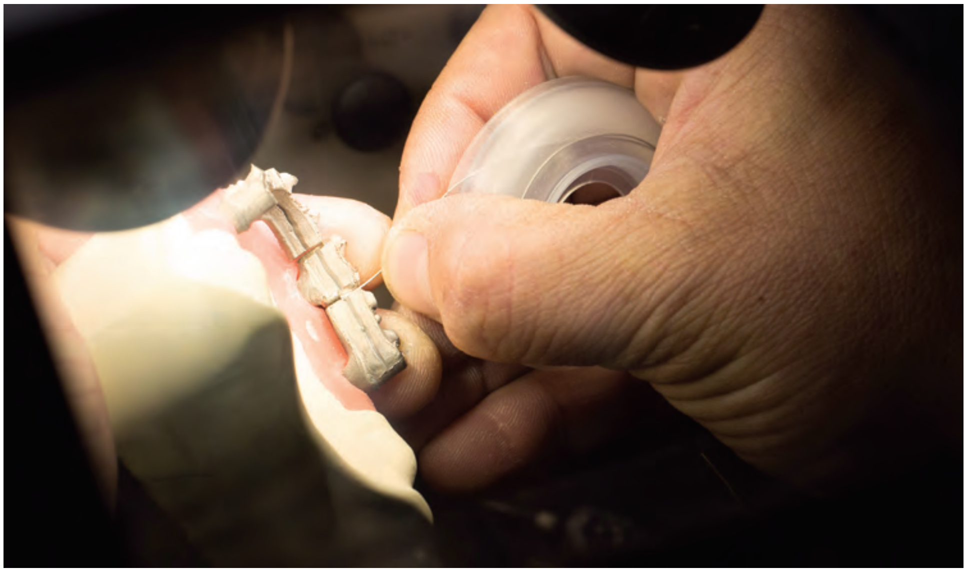


Figure 1: *Soldering process used to attach cast-metal bar segments.*

With Inclusive® CAD/CAM processes (Glidewell Laboratories; Newport Beach, Calif.), specialized software enables the technician to design the bar in a 3-D virtual environment, exercising precise, measurable control over its features and parameters. This digital model is then precisely milled from a solid block of biocompatible, medical-grade titanium alloy. The milled bar is delivered for try-in as a single unit, rather than in segments. Laboratory statistics for the year 2012 indicate an overwhelming rate of success in achieving an ideal, passive fit upon initial seating *(Fig. 2)*. This history suggests a minimal risk of remakes and fosters a high degree of confidence for clinicians seeking to predictably plan these full-arch cases.

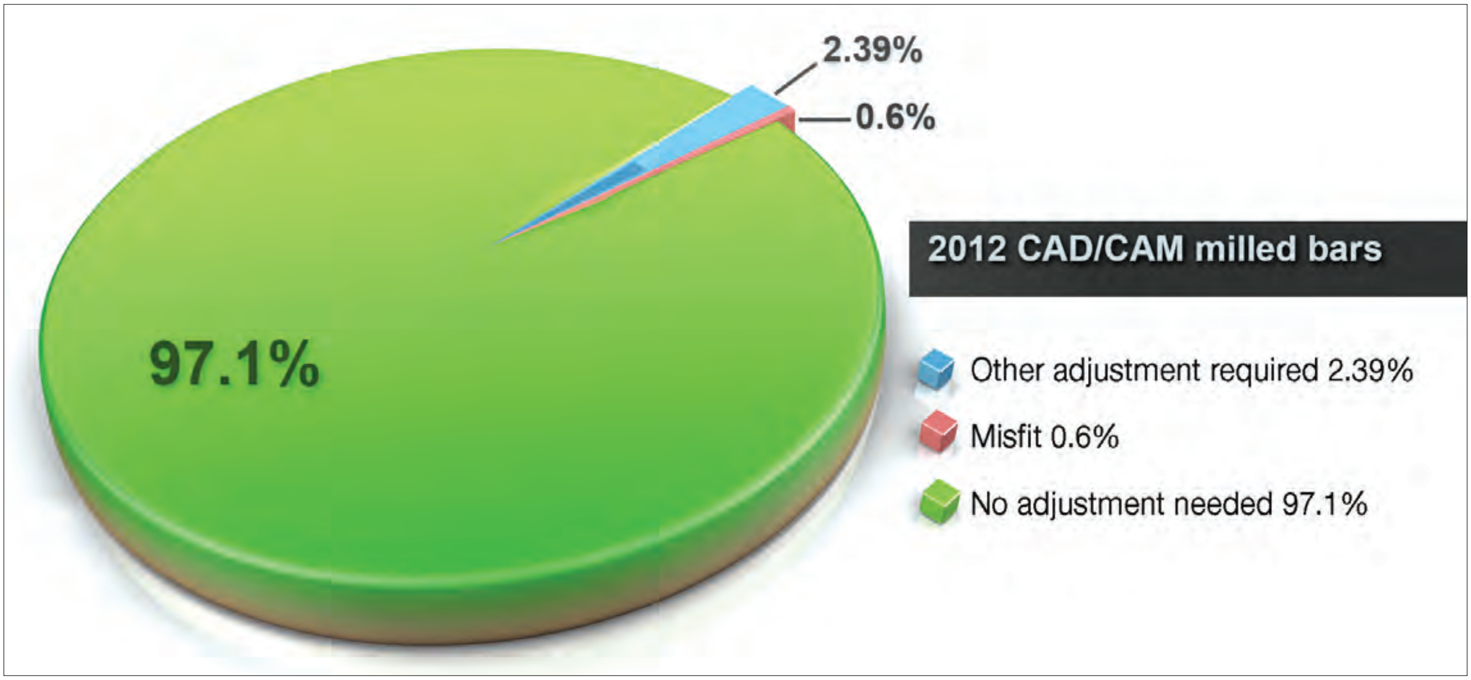


***Figure 2:** Acceptance rate of Inclusive CAD/CAM milled bars in 2012, with percentage and cause of remakes.*

A Stronger Prosthesis

The same digital production processes that enable the precise fit of CAD/CAM milled bars also lend them superior strength when compared to cast-gold implant bars. As a milled, one-piece structure, there are no solder joints resulting from separate segments being laser-welded together *(Fig. 3)*. Nor are there any fractures, cracks, or porosities associated with the lost wax technique by which cast-metal bars are produced. This, combined with the high-strength material properties of titanium alloy *(Fig. 4)*, ensures long-term reliability of the prosthesis. Even in the unlikely event of failure, an exact replica can be milled from the original digital design file, facilitating replacement of the prosthesis without the costly hassle of casting a new bar from scratch. A bar milled from titanium, though significantly stronger, also weighs less than the same bar cast in gold *(Fig. 5)*, resulting in a lighter, more comfortable prosthesis.

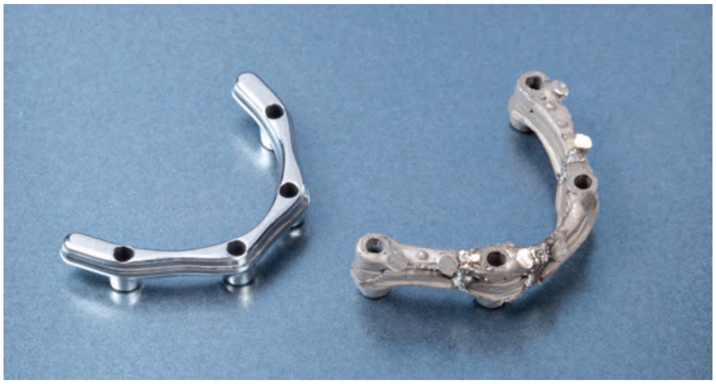


***Figure 3:** A one-piece CAD/CAM milled bar (left) compared to an unfinished cast-metal bar with laser-welded segments.*

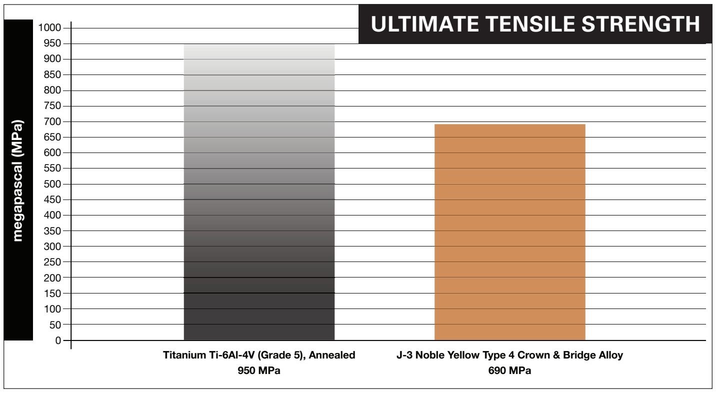


***Figure 4:** The ultimate tensile strength of titanium alloy (950 MPa) is superior to that of gold alloy (690 MPa).*

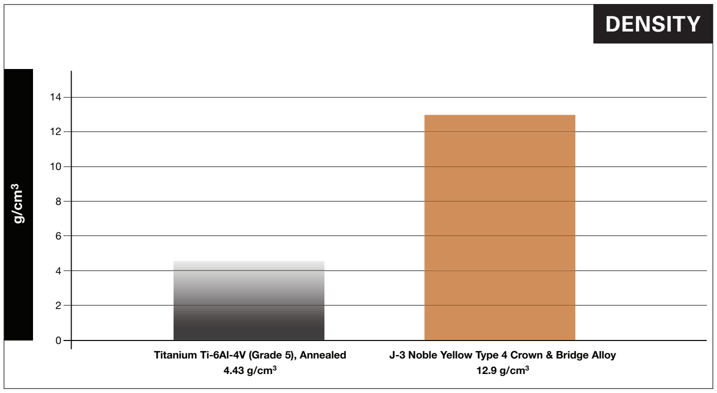


***Figure 5:** The low density of titanium alloy (4.43 g/cm^3) makes it a lightweight material compared to gold alloy (12.9 g/cm^3).*

Case Efficiency

By providing enhanced visibility and superior communication tools in a virtual setting, CAD/CAM technology enhances collaboration between the clinician and laboratory regarding the indications and treatment options for the best possible outcome. Digital production techniques also require less time in the laboratory, resulting in a faster turnaround time for a CAD/CAM milled bar than for a conventional cast-gold bar, helping to reduce overall treatment duration. The elimination of unnecessary appointments or the chairside processes earlier described is a sure means of increasing case efficiency and satisfaction. Furthermore, while the material cost of gold and gold-based alloys continues to climb, titanium remains relatively inexpensive. Because intermediate steps involving components such as UCLAs are not required in the production of CAD/CAM milled bars, labor is reduced. These and other elements contribute to significant savings for both the clinician and patient, maximizing profitability while making a milled bar prosthesis more affordable for a growing edentulous population *(Fig. 6)*.

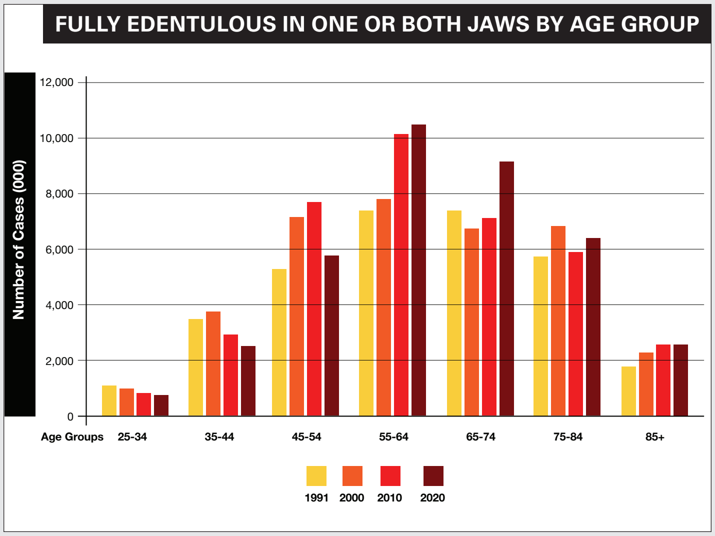


Figure 6: *Statistical projections indicate a continuing rise in total edentulous populations (Source: Chester W. Douglass, DMD, Ph.D, et al., The Journal of Prosthetic Dentistry, January 2002).*

Clinical Flexibility

As digital techniques continue to spur exciting advances within the dental industry, Glidewell Laboratories maintains its position as a technology leader. With a firm commitment to the development of cutting-edge methods and materials, Glidewell supports laboratories of all sizes by offering outsourcing services with the understanding that any implant treatment should be restorative-driven and patient-specific, allowing for maximum clinical flexibility. Inclusive® CAD/CAM Milled Bars are compatible with all major implant systems, and the software allows for a wide variety of bar geometries and attachment configurations *(Fig. 7)*. A dedicated specialist works to carry out each step of the production process for optimal quality. With a high daily case volume and a legacy of service spanning more than 42 years, Glidewell is uniquely positioned to ensure that each case results in a predictable, satisfying outcome.

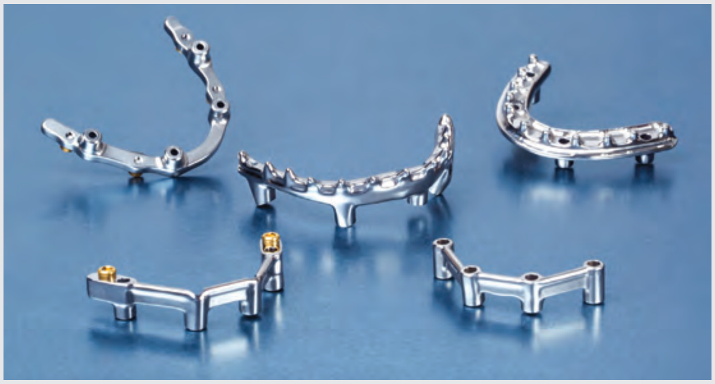
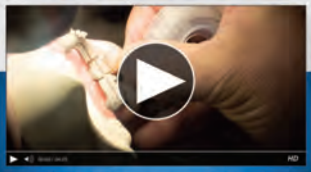


Figure 7: *An assortment of Inclusive CAD/CAM Milled Bars, featuring a variety of geometries and attachment configurations.*

Summary

When undergoing full-arch rehabilitation, most patients would be better served by the superior retention provided by an implant-retained milled bar prosthesis. Further, the strength and stability of any overdenture can be enhanced by the presence of a milled bar framework, which is also intended to distribute stresses exerted on the implants. State-of-the-art processes utilizing digital manufacturing technology eliminate the unpredictable fits and cut-and-solder strength compromises associated with traditional casting techniques. This allows Glidewell Laboratories to offer Inclusive CAD/CAM Milled Bars that are more accurate, less expensive, superior in strength, and faster to produce than conventional cast bars. Best-in-class protocols and CAD/CAM precision increase predictability and reduce chairtime, helping to make a traditionally complex form of treatment affordable, convenient and accessible to patients who will benefit from a reliable fixed-removable implant prosthesis.

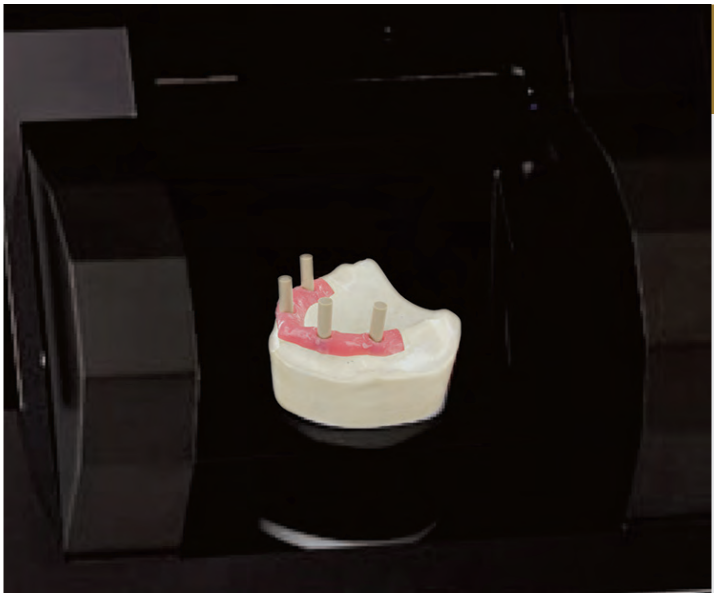
SEE IT IN ACTION



Watch the design video at
www.labperspectives.com

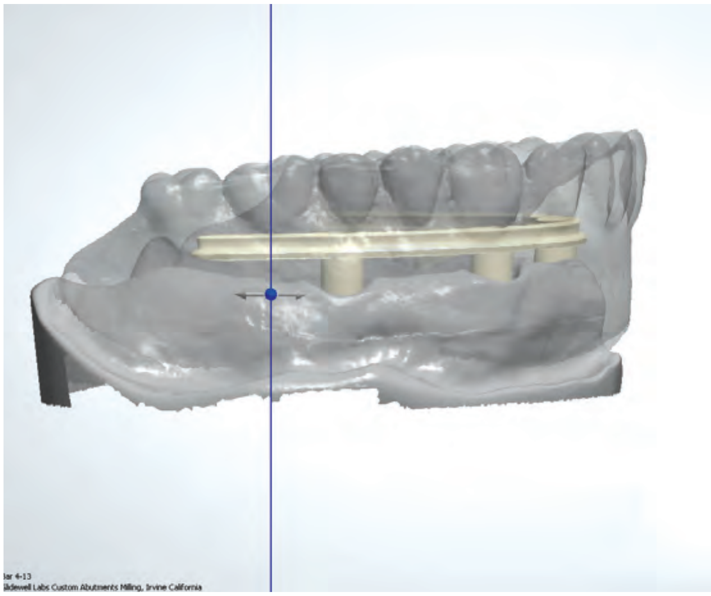
Production WORKFLOW

Inclusive CAD/CAM Milled Bars



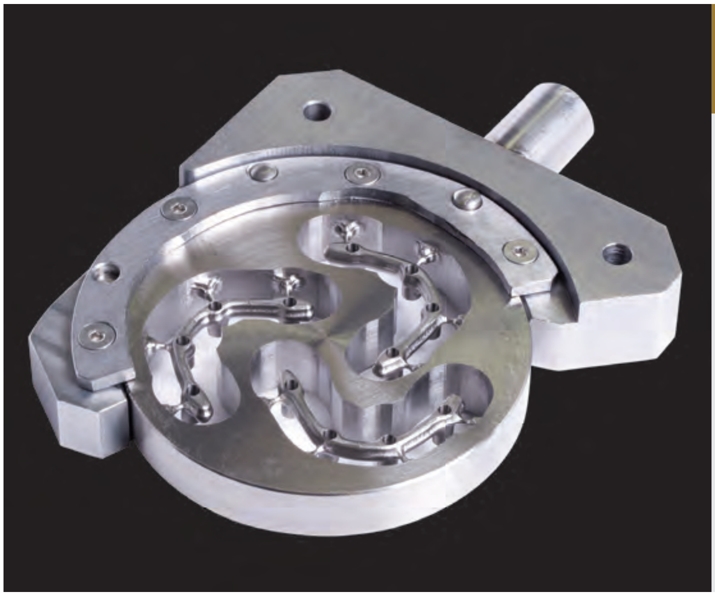
Step 1 SCAN

From final impressions verified with an implant verification jig, the lab produces a stone model. Inclusive® Scanning Abutments for the prescribed implant system are attached to the individual implant analogs. The arch is digitally scanned to produce a 3-D virtual model, with the scanning abutments providing the location, angulation and connection orientation of each implant. Each scanning abutment is physically measured with digital calipers and confirmed to align with master designs contained in the proprietary software library. The denture setup is then scanned, and the resulting 3-D image is superimposed over that of the master model.



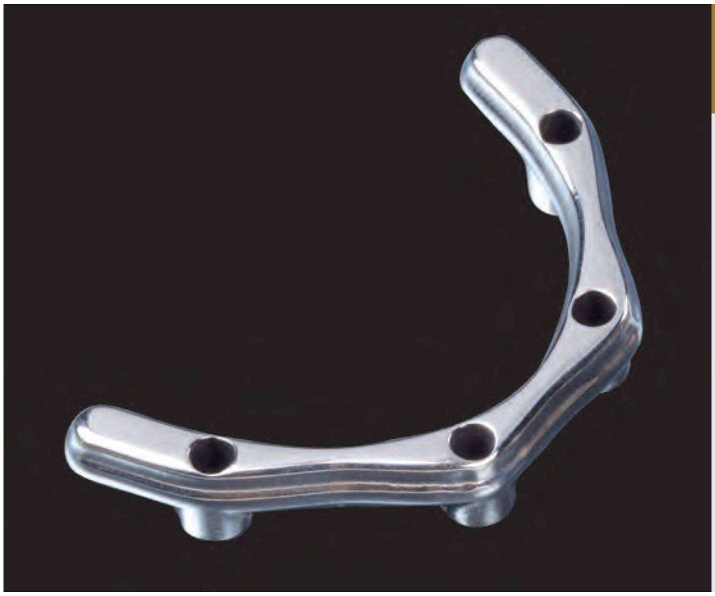
Step 2 DESIGN

With a complete digital rendering of the verified patient model and approved denture setup, a dental technician with CAD expertise designs the bar in a virtual environment. Designs are based on one of the standard bar types available in the software library, or designed from scratch. Whichever base design is chosen, the technician proceeds to manipulate every aspect of the bar with a level of precision measured in mere microns. This enables the technician to set the height of the bar off the tissue as prescribed, and to craft the shape of the bar for maximum strength, optimal comfort and proper support for the acrylic build-up.



Step 3 MILL

Once the final design has been examined and approved, the design file is converted to a file type that can be executed by the milling software. The milling software runs a preliminary routine that nests the virtual bar within a titanium blank and maps out the proper tool path. Once the tool path has been verified and approved, a physical titanium blank is attached to a milling fixture and placed within the highly precise 5-axis mill. Actual milling time varies according to the intricacy of the bar design, but generally requires just a few hours.



Step 4 POLISH

When the milling process is complete, the bar undergoes a proprietary treatment process to ensure maximum flexural strength. The sprues that hold the bar within the block are cut and removed. With implant analogs attached to protect the connection interfaces, the bar is sent through a four-stage automatic polishing process, followed by a final hand polish.

Step 5 FINAL QC

The bar undergoes a final inspection, and is fitted onto the master model to ensure a passive fit, with no rocking and no gaps. The approved bar is then processed into the denture setup (in the case of screw-retained hybrid dentures) or the denture setup is relieved to accommodate the bar (in the case of removable dentures). A complimentary thermoformed nightguard is provided with each screw-retained denture for long-lasting esthetics and function. LP

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BEGO

One-on-ONE

Interview with BEGO USA

Interview of Lou Azzara, Executive Vice President
and Dell Dine, CDT, Chief Dental Technology Officer

by Robin Bartolo, CDT, Glidewell Direct Sales Manager

interview of

Lou Azzara *and* Dell Dine

BEGO USA traces its roots in the dental industry back to 1890, when German Dr. h.c. Wilhelm Herbst developed an innovative procedure for using gold fillings for dental restorations and founded BEGO GmbH. The U.S. division was established in 1991, and in the ensuing years has developed and perfected processes to produce quality metal copings, bridges and restorations from open STL files. President of BEGO USA Lou Azzara and Chief Dental Technology Officer Dell Dine, CDT, discuss with Glidewell Laboratories the importance of having production centers that not only manufacture high quality dental components, but also aid and educate laboratories across the industry on how to utilize the latest tools and systems.

How did you originally get involved in digital dentistry?

Lou Azzara: The BEGO organization started getting involved in 1999, when digital dentistry probably wasn't even a phrase — or at least not a commonly used phrase. Christoph Weiss had the insight that the dental business would begin desiring a higher level of efficiency and increased manufacturing consistency, but wouldn't want to sacrifice the quality that they were accustomed to achieving through their own methods. In 1999, he teamed up with EOS GmbH, the Fraunhofer Institute, a number of software developers, and a host of different engineers involved in both additive and subtractive engineering. He started on the additive side, building with EOS. At that time, EOS did not have a platform to manufacture dental designs; they were building manufacturing prototypes for different industries, but nothing for dentistry. In 1999, they invested, as you can imagine, millions of dollars in this, which resulted in a viable commercial product in 2003. At that time, though, there weren't any open scanning systems or scanning companies who had built partnerships with manufacturing facilities. So BEGO also had to build a scanner so that clients could participate. They pioneered this part of dentistry. Many around the world know BEGO for the premium partial metal Wironium® (BEGO USA; Lincoln, R.I.). The partial side of the business is still incredibly strong. Fast-forward to today, and BEGO is now also one of the largest production centers in the world.

That's a great accomplishment.

LA: What BEGO has done in Germany, across Europe, as well as in other parts of the globe, is to take the expertise that they've built — the manufacturing platforms, the understanding, the resources and the material sciences — and apply it to production equipment for technical services. We are leveraging that know-how and trying to replicate that success here in the United States.

You're looking to replicate the success that they've built in Europe and bring it to the U.S.; now there's a new company, BEGO USA, and you are heading that effort. What's the overall vision for BEGO USA?

LA: To sum it up, BEGO USA is a high performance manufacturer with extreme dental consciousness. What we mean by that is that there's a sensitivity to the uniqueness of dental technology and the needs of lab owners and dental technicians. First, we needed an experienced leader for our production center, and we found that leadership and expertise in Dell Dine. It's not just about the "high performance" equipment. We heard for many years that no one in dentistry wants to pay high prices, and doctors can't discriminate what a particular piece of equipment accomplishes for their practices. The vision that we have is for BEGO USA to be trusted back-end support system with the most precise manufacturing technology, which is easy and affordable for labs to utilize. We are committed to offering the best available brands on the market — such as BruxZir® Solid Zirconia (Glidewell Laboratories; Newport Beach, Calif.) — and optimizing the delivery of those systems. We have a philosophy that if it can be done better or if there can be an improvement, even if it's as little as a micron of a difference, it's worth the investment. And of course, all of this is executed, serviced and managed by a very experienced, highly skilled dental technical team. Anyone who knows Dell can see that he is the perfect person to run our center.

Dell Dine: The way I envision it is that we take every effort to take the advantages of industrial processing and develop it so labs can bring their businesses down a trusted digital path. In my opinion, it is not easy for all of these new technologies to translate into the daily lives of the laboratory. To remedy this, we make some very sophisticated processes readily available to laboratories. That's what we are doing and will continue to build on. When you work with this machinery, you begin to appreciate that it can consistently deliver restorations and frameworks, which is hard to duplicate with the processes that were available prior to the use of such sophisticated equipment. Yet, as Lou said, we do this with a deep sense of "dental consciousness": the full understanding that we are servicing the needs of the lab.

It makes a huge difference. You have all this technology; you have all this knowledge; you have a very clear vision that if it's better, you're going to introduce it to the market; and you're going to partner with the right companies. How would you describe your business model, and what kind of digital solutions are you going to provide to the dental laboratory?

LA: In order to be a trusted source for our clients, we first have to have the product selection that's most demanded — BruxZir Solid Zirconia, IPS e.max® (Ivoclar Vivadent; Amherst NY) — the products that are popular for good reason, popular because they're good materials, and they're good solutions. We're going to provide the most demanded and best solutions wrapped around a high degree of technical services. As Dell said, choosing the right technology and making the right choices in that regard are going to influence the outcome in a positive way. But, it also requires a lot of guidance. As labs are trying materials for the first time or being introduced to new types of materials, they need someone who can produce these materials at a high level, and they need helpful and relevant guidance and a knowledgeable source on the phone about the materials and their usage.

In the digital world, it's not simply putting a case in a box. In order for a restoration to be produced, the file has to be designed, transferred and controlled at every step along with way. One of the amazing things about our BEGO solution is that we possess a world-class file transfer system that makes it fast and easy for laboratories to send work and manage quality at every stage through the process. At each and every step, the product is being checked, both by quality control software systems and professional technicians. It really is amazing.

Based on what you just shared, it sounds like speed and professional guidance services are really important issues for dental laboratories that are expanding into digital manufacturing. So they're looking to you for guidance on how to put it all together, this maze of technology, speed and conversion. Is that how you see your role? As bringing it all together while helping them get past that initial hurdle?

DD: Robin, I think you're right. As a previous lab owner and someone who was responsible for implementing technology throughout a network of labs, the real challenge for digital dentistry is not the investment in scanners and CAD programs; rather, it is that we now rely on others to interpret our data and give us feedback. Dental technicians historically have learned through seeing the results of their work in person and making adjustments each day to evolve and improve. At BEGO we are fortunate that we have sophisticated software that analyzes the files as they come in. We

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then have a great team that is committed to quickly reaching out to clients to make sure we are all on the same page and that there are no surprises after delivery. We spend a fair amount of time working with clients and dialing in their settings in the software so they get results that go beyond what they expect; results as if they were seeing the output come out of the machines themselves. We're finding that there's a big communication responsibility that outsource centers need to uphold. We are embracing this responsibility and I believe our clients deeply appreciate it.

Yes, definitely. There's a steep learning curve. And unfortunately, there's a lot of misinformation or misunderstanding that laboratories newest to the digital marketplace are having to sort through as they try to get an understanding of which option is best for them. That's a critical component that both your company and ours have to deal with.

DD: Yes, it's a huge support effort. It is important to me personally, and as a team feel very obligated to supporting labs and their efforts to change their business models successfully.

Describe what the typical steps would be for laboratories that partner with you as an outsource solution provider, and how you get them to partner with you.

LA: It's really simple. We add a file on their design center PC. And through a very short, very efficient and effective testing process, we dial in the correct parameters. We have our standard parameters that work for the overwhelming majority of laboratories. But as you know, there are certain preferences among labs, and within the labs among their doctors; preferences such as tight or loose are fully defined in context with what the lab's doctor preferences are. We'll calibrate those steps to make sure that the labs are comfortable. Once that process is complete, those calibrations stay consistent. And, we have invested a lot into making sure our output for the lab stays consistent. Yes, we have invested in high-performance manufacturing equipment; but, we complimented that investment with an investment in analytical systems and software that allow us to manage the equipment at a very high level. We certainly take great pride in our consistency.

You give them all the settings, you put them in the computer;

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but how do you ensure that information doesn't get changed, either over time, or for one particular reason that then deviates from the proven formula you've come up with?

DD: We review all incoming case files for manufacturability. That's the key thing. Every file that comes in is reviewed to ensure that it can be manufactured. If it's not possible, we will contact clients and explain what needs to be changed. This is done within 20 minutes of receiving the file. The lab then can go in and make those adjustments themselves. We also inform them when designs might be reaching a threshold where the manufacturing output has a lower probability of success. The worst thing that can happen to a lab is a situation that delays a case. We certainly don't want our calls to go out to a lab the night before a case is due. Our BEGO systems are designed to do the file evaluations early and fast, as well as to be highly interactive with clients. I wish I had access to this type of service when I owned my lab. Sometimes, especially with new clients who are just beginning to use these systems, even when we share with them that there might be a problem, they won't know how to change it. For this reason, we developed a department that will work through the process again — possibly by taking control of their computer and showing them how they can make the changes. We are focused on developing a platform where labs can achieve a real comfort level, knowing that what they design is what we can manufacture and will come back to them on time and as expected. No surprises.

That's a fantastic service. Speaking from my experience, the service is especially critical in the beginning because there are so many bells, whistles, switches, toggles, and things they can control and change. It can be very overwhelming at first. All of a sudden, they lose sight of what's important, and can get a file that can't be manufactured. Maybe they've stopped thinking about the connectors, or the contacts aren't where they need to be. And while they may have done their very best, they were overwhelmed with the number of choices and options. So it's a great service that you provide there.

DD: Labs are trying to do their designs as accurately and expediently as possible. We hope they learn to depend on BEGO as a second pair of eyes to back up the reliability of their service.

Back to the baseline and start from there. I know that this is early in the process, but can you share a little bit about your growth rate and what your customers are telling you about your services at this stage?

LA: It has been so fulfilling, and I'm so proud to be a part of this type of approach, as well as to have the investment and trust that BEGO Germany has placed in us. It is fun to share all the accolades we're getting from clients today, not only on the quality of restorations we're able to manufacture, but as importantly, on the level of service. Althought they are important, it's not just about the percentages; it can't just be that there are only 0.5 percent remakes. It's the mind-set internally where one case that the lab is counting on needs to be 100 percent at an exact moment. It has been incredibly fulfilling and rewarding to be a part of getting that right; not only the ability to make it correctly no matter how elaborate or complex, but also to service it correctly, guide it correctly and get it there consistently on time. It really empowers us to move forward more aggressively.

DD: The growth and positive feedback have been very significant. There are many examples of this whether it is from the SLM, design or milling side of the business. One great example is how well the BruxZir brand is received. I have to say, it has had a truly positive impact on our business and the businesses of our clients.

That's great.

LA: It's certainly nice getting those compliments, getting those e-mails, those phone calls, and hearing the praise coming through to our team; but the proof is in the appetite and trust to send more files. As Dell pointed out, we have quadrupled since our launch, which was about 10 weeks ago. The best thing about that record is that it was only set yesterday. The previous week was a new record, and the week before was another record. We are very excited, very fulfilled and honored that we're earning the trust of the labs that we love to serve.

Not only are you setting records, but also you're setting record records because each week is a new record.

LA: Dell has done a tremendous job preparing our outstanding team for that. These records come because of great products and great technology, but they really stay and they persist week after week because of great people. He has put together a tremendous team that is highly experienced and incredibly motivated. They really feed off the adrenaline of the increased level of trust that clients have placed in us.

Of all the choices for full zirconia that are on the market today, why did you make the decision to offer BruxZir Solid Zirconia to your customers?

LA: Watching how BruxZir Solid Zirconia has impacted the market and labs in such a positive way, as well as hearing the commentary and the positive remarks from doctors across the country, it was the obvious choice if we were thinking about being in the zirconia full-contour market. BruxZir is the market leader, without question the most recognizable brand, and Glidewell is a partner that we are extremely proud to be associated with. What

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was expected, I would say, but also very rewarding, is the incredible feedback that we're getting from the results with BruxZir Solid Zirconia.

That's fantastic.

DD: The feedback is fantastic from the technicians who are producing with it. The remake percentage that we have here is in the "point" numbers, around 0.2 percent. They want something that can produce consistently. With the shades that we get, we hit them almost perfectly; the entire time I've been here, we have only had one shading issue. The shades are very well accepted. We're using the BruxZir™ Shaded Milling Blanks (Glidewell Direct; Irvine, Calif.), and they're just so consistent. It's such a pleasure to work with that because our real essence is providing consistency. The quality is a given. You want to be sure that you're providing that consistency to those clients so they know what to expect when they get it back. That's so critical when you're in the lab. That material for us is just a core component.

You've hit it on the head. With the introduction of the BruxZir Shaded material, obviously the concerns of inconsistency with the dipping and the drying and all those variables that were part of the early process have been eliminated. Now you know with confidence that if you pick a specific block, you're going to get the same result out of it time and time again. It's nice to see that helps you deliver that consistency to your customers.

DD: That's all part and parcel of that very, very low rejection rate. It's almost non-existent.

That's great, and we'll definitely work hard to keep it that way. Looking to the future, what new products and services are you planning on offering to your laboratories?

LA: Touching a little on BEGO history, the BEGO organization has a long 123-year history, actually approaching 124. The focus has been frame mastery — frameworks in removables, partial dentures and crown & bridge. BEGO really focused not just on the material part of it, but on mastering systems that made frameworks. That's from waxes, to investments, to the materials, the metals, to actual equipment, so that the precision and the consistency were always top performance. Fast-forward to the future, we're really going to utilize that mastery. Mastery has been defined over the years in different ways: There's mastery of materials, equipment and technology, mastery of service, and mastery of education. Mastering the service component enables labs to optimize the full potential of these systems in the analog world and in the digital world. BEGO has dedicated over 15 percent of its annual resources to education, and 20 percent of its real estate is education facilities, including staffing over 15 educators on site and a vast army of educators globally to help build out the systems and ensure they're in the context of dental solutions. Going forward, there's going to be a tremendous amount of focus on bringing that mastery and pushing it into the digital world. You'll see a lot of innovation on the removables side, continuous innovation of fixed crown & bridge, and a wide breadth of offerings in the implant segment of the market.

Very exciting times.

DD: It is. And I believe that we have great processes in place, and as the materials improve and develop, we'll just be adding those materials into milling, laser-sintering or printing processes. We are in a great position to just add materials and stay with the very positive trends in dentistry.

We're excited about the opportunity to get feedback from both of you and appreciate your time, and appreciate your willingness to share your thoughts and vision. The early success you've enjoyed is certainly boding well for the future. We are very proud to be partners with BEGO USA. We're looking forward to your continued success, and building ours as well. This is a great time in the industry, especially with all this technology coming to the forefront. As you eloquently stated, there's so much information, somebody needs to help the laboratories distill it, understand it and process it in a way that they can take advantage of it, as opposed to getting overwhelmed and saying, "This is too complicated, I'm going to pass on it."

LA: I think that the best days for this industry are ahead of us. One of the most critical decisions that laboratories will make to access those opportunities is going to be their sourcing partner, who they're working with. Our decision to choose Glidewell as our partner with full-contour zirconia was mission-critical to our success. I believe that laboratories, as they look over the landscape and as they access the opportunities that the market is affording them, will come to the most critical decision: Who is a good partner? Who is going to help me elevate and access what's in front of us? Without question, our best days are ahead.

Thank you both for your time. LP

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